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in the University of California

Edited by

T. H. Goodspeed

Professor of Botany, and
Director of Botanical Gardens,
in the University of California.

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ADDRESS OF THE PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES

By Professor FRANK R. LILLIE

UNIVERSITY OF CHICAGO

Members and Friends of the National Academy of Sciences:

WE welcome your presence at the annual dinner of the National Academy of Sciences, an occasion devoted to the charms of friendly intercourse and the conferring of such honorary awards of the academy as may fall due and be recommended by appropriate committees after careful investigation.

This is in no sense therefore a business meeting of the academy; but my distinguished predecessor, Dr. W. W. Campbell, director emeritus of the Lick Observatory and president emeritus of the University of California, created a precedent of speaking on the status of the academy on this occasion, which I have been requested by the committee in charge of arrangements for this meeting to continue.

At the last two annual dinners Dr. Campbell presented the history of the academy and emphasized especially the obligation that rests upon members of the academy under its congressional charter "whenever called upon by any Department of the Government to investigate, examine, experiment and report upon any subject of science or art" without any compensation whatever for such services.

May I, in my turn, remind you that this building is also the building of the National Research Council, and that the names of both the academy and the research council appear over its door. The National Research Council was organized by the academy in 1916 under its congressional charter, as a measure of national preparedness, at the request of President Wilson; and was perpetuated by the academy in 1918

at the request, and under executive order, of the same great President, in order to develop more fully and effectively purposes stated and implicit in the charter of the academy, which in course of time had resulted in functions so various and important that a special executive branch of the academy was needed for their proper performance.

Prior to the current year the presidency of the academy and the chairmanship of the National Research Council were held by different persons, and for the first time during the current year these two offices have been united with the aim of bringing about closer correlation of operation between the academy and the council. I think it may be said that this aim has been to some extent realized. The proper performance of both duties, however, presupposes a degree of vigor and activity that only a younger person could hope to possess; and it therefore seems indicated that as soon as possible a separation of these offices should again take place.

The current year has also been marked by the union of the Science Advisory Board with the Committee on Government Relations of the National Academy of Sciences with the idea of centralizing the performance of our charter obligations to the government which had become scattered among two or three bodies of the academy and the council. The distinguished services of the Science Advisory Board are well known and are permanently recorded in its published reports. The benefit of these services has carried over; and, during the current year, not only have certain of the committees of the Science Advisory Board been continued, but new requests for aid and advice of the academy have been received from the departments of commerce, agriculture and the navy, and also from the

National Resources Committee, which are now in process of examination.

An unusually enjoyable and well-attended autumn meeting of the academy was held at the University of Virginia last November, when the pleasures of Southern hospitality were experienced to the full. The academy has accepted an invitation from the University of Chicago to hold its next autumn meeting in November of this year in those equally delightful, but very different, surroundings. The autumn meetings of the academy carry the message of the academy to different regions of the country in successive years.

For the rest I can only say that the academy remains firmly founded on the bed-rock of scientific research, and serene in confidence in orderly thought, whether for the understanding or control of the processes in nature and in man. If any change of attitude is to be noted, it is in an increased state of consciousness of public and social responsibility, which developed rapidly under the stress of the great war, and of these recent times of economic depression, stimulated by an awakened public confidence and interest in science. There is no present danger, in our country at least, that scientific discovery and thought should be underestimated or suppressed; this condition should heighten our sense of responsibility to see that its power and authority are not exaggerated. The true friends of science recognize that limitations are set in nature and in the mind itself to scientific progress. We can not predict its rate, direction or extent for any considerable period of time. Yet I think that experience should give us confidence to claim that the conquering spirit of science is one of the strongest components of ideal social processes; and always will be.

MEDALS OF THE NATIONAL ACADEMY OF SCIENCES

PRESENTATION OF THE AGASSIZ MEDAL TO DR. THOMAS WAYLAND VAUGHAN

THOMAS WAYLAND VAUGHAN, long a member of the academy, is so well known to most of you here tonight that there is no occasion to outline his biography, or to dwell on his many scientific publications; my privilege is, rather, to present to you the essence of why he has been adjudged most worthy recipient of the Agassiz Medal for eminence in the science of the sea. The oceanographer is constantly reminded that understanding of the margins of the oceans, and of the parts of the earth's crust on which the latter rest, is as integral a part of his science as is examination of the waters themselves, for these geologic features determine the extent, depths and circulatory systems of the oceans, with all that this applies. Conversely, we

can not hope to understand the geology of continents or of islands until we understand the structure and history of continental shelves, of ocean floors or of the great corrugations of the latter. It is, therefore, eminently fitting that the academy should honor one who, commencing his career as a geologist, soon turned to the geological history of shore lines and of the sediments of the sea—especially when we remember that the donor of the medal, Sir John Murray, was himself the most eminent student of oceanic deposits. We see Vaughan's genius and the part he has played in the progressive unfolding of submarine geology in his studies of the corals and coral reefs of past ages, of the history of the islands of the West Indies and of the Floridian almost-island; of the organic skeletons that accumulated on the sea floor in past geologic ages.

as exemplified especially by the fossil Foraminifera; leading, in order of evolution, to his examination of the composition of modern sediments, Atlantic and Pacific.

However, if I could, I would paint a word picture of Vaughan's great and unique service to oceanography in quite another field. For centuries past, the Pacific had carried the commerce and navies of the nations on their lawful occasions; and the nature of its surface waters had been examined, at many hands. Yet, the vast underlying bulk of Pacific waters hid their secrets. And a few years ago an area still remained, off to the westward of lower California, twice as large as the Republic of Mexico, still to be violated by its first sounding; a *terra incognita* extended from Hawaii toward the Aleutians and Japan, larger in area than the continental United States, cut by only one line of landings; and still to be marked by a single measurement (by modern standards) of the physical or chemical nature of the underlying waters. That the picture has now changed—that scientific observation, by different nations, has been focused on the wastes of the Pacific, the greatest unexplored areas on our planet—that the future of oceanography in the Pacific is now rosy, we have Wayland Vaughan chiefly to thank.

Of the many-sided ways he has brought this about, time lets me speak in particular only of his work at the Scripps Institution, for this illustrates the master's touch. Vaughan came in 1925 to direct this, one of the few institutions of its sort in the world. Thenceforth—reading between the lines—we see his intellectual leadership, see him projecting his thought ahead along all the avenues of research that have led there, to such wide advances in knowledge of Pacific circulation in general, of Californian up-welling waters and their effects on organic fertility, of ocean dynamics, of the interrelation between sea temperatures and meteorologic phenomena.

As a last evidence of the esteem in which Vaughan is held by his scientific colleagues I may quote the saying that "great men have great and little men have little men to succeed them." It is no secret that the day of Vaughan's retirement in the Scripps Institution draws near and that one of the most eminent of physical oceanographers is to be his successor.

HENRY B. BIGELOW

WOODS HOLE OCEANOGRAPHICAL
INSTITUTION

RESPONSE OF THE MEDALLIST

President Lillie, Dr. Bigelow and other members of the
National Academy of Sciences:

I THANK you for having selected me as the recipient of the Agassiz Medal for the year 1935. Besides my high appreciation of the honor that the National

Academy has conferred on me, I feel deep personal satisfaction because of the association that I had for years with Mr. Alexander Agassiz and Sir John Murray.

It has been the custom for recipients of medals from the academy to give short accounts of their personal researches. After I graduated, with a major in physics, at Tulane University in New Orleans in 1889, I was for three years a teacher of physics and chemistry in a junior college in the village of Mt. Lebanon in northwestern Louisiana. Around that village there were many excellent exposures of marine fossiliferous deposits of middle Eocene age. They attracted my attention and I immediately began to collect fossils and to make studies of the local geology. I wished to ascertain the conditions in the sea under which the different organisms once lived and under which the enclosing sediments had been deposited. The series of questions that presented themselves determined the course of my life.

The purpose of most of my scientific work has been to add to knowledge of geological history by studies of marine geological formations—both the organisms contained in and the other materials composing such deposits. I had not advanced far in such studies before it became obvious that the only reliable basis for interpreting the past was knowledge of conditions under which organisms now live and under which the various kinds of marine sediments are now deposited in the sea. Occasionally some of my geological friends have accused me of having deserted geology. My reply to such accusations has been that I have not abandoned geological investigations, I have merely shifted emphasis from the product to the process aspect of the science.

The fact that the Agassiz Medal has been awarded to me is evidence that in the opinion of my scientific colleagues I have accomplished something of value. This greatly pleases me, but I must say that without the support of several powerful scientific organizations and the assistance of many scientific colleagues what I have done would not have been possible. I wish to express to the officials and other colleagues in the United States Geological Survey and to the officials and other colleagues in the Smithsonian Institution thanks for the support that they have given to my work through more than forty years. I am still a member of the staff of each of those organizations and their help has continued uninterruptedly to the present. I am also under obligations to the Carnegie Institution of Washington, particularly to my old friend, Alfred G. Mayor, for assistance from that source. The University of California and the members of the staff of the Scripps Institution of Oceanography have helped me in more ways than I can mention in these

few words. I have also had assistance from many organizations and many individuals whom I can not here name. To all the organizations and to all my scientific colleagues who have helped me I wish to express my gratitude.

I mentioned that for years I was associated with Mr. Alexander Agassiz and Sir John Murray. While I was a graduate student at Harvard in 1892-94 Mr. Agassiz first asked me to help him with the identification of some of the corals that he had collected in his expeditions in Florida and the West Indies. This initiated between him and me a rather close relation which continued until his death in March, 1910.

In the recent discussions of coral reefs and the hypotheses for their formation sight has almost been lost of Alexander Agassiz's researches on coral reefs and of his valid contributions to knowledge of them. We now have reason to believe that a considerable part of his interpretations of the history of reefs was not well founded, for instance, he did not recognize the evidence of coastal submergence in many coral reef areas and he did not recognize that the surface waters in those areas will not dissolve limestone, but much of his work was sound and some of his important opinions have recently been corroborated. I wish particularly to call attention to the results obtained by J. Edward Hoffmeister and Harry S. Ladd in the Fiji and Tonga Islands. That many of the reefs in those regions are growing as veneers on limestones of Tertiary age, largely not of coral origin, has been demonstrated.

I first met Sir John Murray in Russia at the International Geological Congress there in 1897. At this congress he manifested one of his characteristic traits. Instead of devoting his attention to the older scientific men he asked a group of young American geologists if he might join it. We felt honored, and thereafter he drank, smoked and told stories with us so long as we could be together. The result was, at least for me, the formation of a friendship which lasted until he died. The last communication that I had from him, before his death in a motor accident in March, 1914, was a copy of his small volume, "The Ocean," the dedication note accompanying which is dated 5th November, 1913.

This medal, therefore, has for me significance in that the fund to establish it was contributed by one of my dear friends, and it is in memory of a man with whom I had close and friendly relations for many years.

A few remarks about some of the efforts made to promote oceanographic research in the United States between 1910 and the establishment of the Scripps Institution of Oceanography in 1925 may be of interest. In 1911 after Sir John Murray had delivered in Cambridge his memorial address on Alexander Agassiz, he and Lady Murray came to Washington and spent several months here, having an apartment in the Shore-

ham Hotel, across the street from the Cosmos Club, for which he had a visitor's card. While he was here I saw him almost every day. He did not only what he could to encourage oceanographic interest among those whom he met in Washington, but he also tried to bring about oceanographic research on the west side of the North Atlantic which would conform in method and be contemporaneous with the investigations that were being conducted on the east side of the North Atlantic under the auspices of the International Council for the Exploration of the Sea and with the work of such distinguished Norwegians as Helland-Hansen, Fridtjof Nansen and others. After leaving Washington he went to New York where Professor Henry Fairfield Osborn organized a dinner for him concerning which he said in a letter to Sir William Herdman, "Osborn is to have fourteen millionaires to hear me at the Museum as to what they should do for the study of the Ocean!! May it have some effect!" The attempt to establish an oceanographic institution at that time, 1911, was not successful, but the effect of Sir John Murray's efforts to promote oceanographic research in the United States was continuing.

A few years later when Nansen was in Washington, I think it was in January, 1918, a group of 25 or 30 scientific men interested in oceanography gave him a dinner at the Cosmos Club, and after dinner he delivered an informal address on oceanography. Nansen especially emphasized the necessity for the intensive study of oceanic circulation. His advocacy of oceanographic research in the United States did not bear immediate fruit, but his influence was similar to that of Sir John Murray in that it was one of the factors that later helped in the development of oceanography in this country. As has already been said, I was personally associated with Sir John Murray in his efforts to advance the study of the ocean in this country; and I was one of those who attended the dinner in Nansen's honor and subsequently took part in the discussion of his able address.

For some reason, which I do not know, it was decided before Dr. W. E. Ritter's retirement from the directorship of the "Scripps Institution of Biological Research" to convert the institution into one for oceanographic research. In 1923 I was offered the directorship of the institution, and its name was changed on October 25, 1925, from "Scripps Institution for Biological Research" to "Scripps Institution of Oceanography." Therefore the Scripps Institution of Oceanography was the first institution in the United States that had for its major purpose the prosecution of research on the ocean.

It was about 1924 that Dr. Wickliffe Rose, of the Rockefeller Foundation, became interested in the promotion of oceanography. Shortly after that the Na-

tional Academy Committee on Oceanography was established, and as a result of its efforts the Woods Hole Oceanographical Institution was founded, assistance was given to the establishment of the Oceanographic Laboratories of the University of Washington, and some help was given to the Scripps Institution of Oceanography.

Since I think that the efforts of Sir John Murray and Nansen to promote oceanographic research in the United States are not generally known, the statement that I have made may be of some historic interest.

In closing I wish to reiterate my thanks to the members of the National Academy for conferring this medal upon me and again to pay homage to my two old friends, Mr. Alexander Agassiz and Sir John Murray.

T. WAYLAND VAUGHAN

PRESENTATION OF THE PUBLIC WELFARE MEDAL TO DR. FREDERICK FULLER RUSSELL

THE curiosities which stimulate the development of the sciences are sometimes derived from abstract contemplation of the known facts and their cataloging concepts. These curiosities arise with compelling insistence, however, when a scientifically conceived attack on an important practical problem reveals the inadequacies of existing knowledge. The achievements of Frederick Fuller Russell are important examples of the successful application of science to human welfare, and illustrate the advance of science through the interplay of theory and practice.

After receiving his medical degree at the College of Physicians and Surgeons of Columbia University, and continuing his studies in Germany, Russell joined the army at the outbreak of the Spanish-American war. He spent three years in Puerto Rico, then taught bacteriology and pathology at the Army Medical School and at George Washington University. In 1914 he went to Vera Cruz with the army of occupation and later served in Panama. In the world war, as assistant to the Surgeon General, he organized and administered the Division of Laboratories and Infectious Disease of the Surgeon General's office. He received the Distinguished Service Medal in 1919.

Russell's work throughout this period showed the qualities of practicality, drive to fundamentals and scientific curiosity which characterized his later years. His bacteriological studies yielded important results, an example being the Russell Double Sugar Medium by means of which recognition of typhoid became easy and positive. One contribution, however, was so vitally important as to overshadow the others. He simplified and systematized the procedures for vaccination against typhoid which had been studied ex-

perimentally in the laboratories, gave a mass demonstration of its safety and certainty of protection by introducing it in the army with such immediate and complete success that it became standard practice almost over night. It might be possible to estimate the number of lives saved under ordinary conditions by this procedure, but what the death rate from typhoid would have been without it during the world war can be only imagined.

Russell's active service in the army medical work ended in 1920. In that year Dr. Wickliffe Rose, who had organized the public health work of the Rockefeller Foundation, invited him to join in the work as director of laboratory service. Russell resigned from the army, and was commissioned a Brigadier-General in the Reserve Officers Medical Corps the following year. In 1923 he succeeded Rose as director of the International Health Division, a position he held until his retirement from the foundation in 1935, when he became a lecturer in public health at Harvard University.

Russell brought to the Foundation high abilities for administration as well as unusual aptitude and training in scientific medicine. Under his direction the International Health Division continued its sympathetic and understanding cooperation with governments in building up public health organizations and in training public health personnel, and intensified the efforts of its own staff in disease control. To Russell disease control meant the study of disease in its environment, by men of thorough scientific competence. This field work was backed by basic laboratory work at home, and constant interplay between field and laboratory ensured the rapid application in the field of new laboratory findings, while the studies and experiences in the field stimulated new research at home. Only by insistence upon this unity of effort could such remarkable progress have been gained in the etiology and control of malaria and yellow fever as was accomplished by the staff during Russell's leadership.

The story of these achievements has been told elsewhere. The complexities met with in malaria control have led to much greater understanding of the nature of the disease and of its carriers, and the previous pessimism regarding its eradication has disappeared. Through dangerous and unforgettable days of hope and disappointment the struggle for control of yellow fever went forward. Under Russell's generalship the staff in Africa, South America and New York worked as a unit, braving and suffering sickness and death from the insidious virus. For weeks and months Russell's deep concern for the safety of the staff brought him close to ordering a discontinuance of the work, and his days and nights were heavy. But step by step

new knowledge came, and finally safety, with the securing of an inoculation technique which gave positive immunity. Now with increasing speed fundamental knowledge could be gained without the sacrifice of health or life, knowledge from which we know the endemic areas, more of the etiology of the disease, more of the nature of the virus.

Such is the nature of the work of Russell, the scientist and the administrator. Those of us who have counted him as a colleague and love him as a friend alone know the full measure of the man.

MAX MASON

RESPONSE OF THE MEDALLIST

Mr. President, Mr. Mason, Members of the National Academy of Sciences, Ladies and Gentlemen: I thank you most sincerely for the honor you have done me in presenting me with the Marcellus Hartley medal. I realize, as you all do, that the medal is given me because I was the director of a group of workers, and that the honor is for the group and that on this occasion I merely represent it.

Ever since I heard of the Marcellus Hartley plan I have been most interested in the idea and have wondered at the clever insight into affairs as they are, which is shown by the donors of the medal. You all know, especially those of you who have worked with governments, that they feel that each government has reputation and prestige to maintain, and that a government may be just as jealous of its reputation, in any field, as are some of the sensitive individuals that we all know. It is therefore quite true that work done in aid of governments may receive little recognition by the public and that only those, such as the members of the academy, are in a position to know the facts of each case. To the workers themselves, in such cooperative work, the desire for credit plays a very small part. They are as a rule, and especially if successful, quite content to see the march of progress from the side-lines, and to get their satisfaction from seeing the improvements in public health and the elevation of the general welfare of the people, and to be quite without feeling as to who receives the credit, since the government itself usually arranges for the publication of all reports on cooperative undertakings, and rightly so, since successful innovations become a regular part of the government program for the future.

The director of a voluntary organization, as contrasted with a government bureau, sits in the background; his work, in a general way, resembles that of the chess player; he can choose his knights and bishops and rooks and pawns, and move them into place for the opening of the game, but after that he cooperates, that is, he watches the game, makes moves at critical periods and then waits for a move from the other side.

It is often slow, but always interesting, for there are many opportunities for suggestions, for the introduction of new elements of personnel, materials and ideas, and watchful waiting is essential.

With such conditions to deal with, one would not be very active with one game, at a time, so it has long been our custom to have several games proceeding simultaneously, and the director moves carefully from one to another, always looking for an opportunity to make a gain in some one of the projects. Obviously, one could overdo this sort of thing, and have so many games running that the scattering of effort would result in lack of concentration and wasted energy. We, therefore, always limited the number of projects, and since human life, especially its active part, is relatively short, we chose short diseases, to be used as demonstrations in the teaching of public health. Little can be done by decree, as you know, in influencing the habits of a people, so that the main point of effort has always been in education toward better things. Cancer, tuberculosis, leprosy are examples of long-drawn-out diseases, and in tuberculosis and leprosy the patient may live as long as the investigator. So we chose short diseases for demonstrations and studies. Yellow fever and malaria and hookworm are examples of such short and simple diseases that are, at least on their face, easily understood by the laity and therefore good for the purposes of education.

Very early in our work we learned that existing knowledge, no matter how extensive, was rarely adequate for practical control; there were too many loopholes in our knowledge, so we learned that we must carry out studies of each disease in its own environment as we endeavored to bring it under control, or to bring about its eradication. The basis of our programs became simultaneous study and control, in the field, and under natural conditions; only in this way could we acquire the necessary scientific basis for real progress at a cost within the means of the population involved, and that system has produced worth-while results, and there has been a constant tendency to lay more and more stress on field research as time went on, since obviously more accurate knowledge of the problems involved permitted us to carry out campaigns of control at a constantly diminishing cost in money and in personnel.

An example of such an effort is furnished by the yellow fever work. You have all heard of yellow fever as a disease from which we formerly suffered at irregular intervals, but to most of us in this part of the world the disease is no longer a threat, and some of us may even look upon it as an extinct disease. For us in the United States it was, until the introduction of travel by air. In former days, the disease was carried by sailing vessels and they bred the necessary mosquitoes in the open water butts; with the introduc-

tion of steam vessels, which carried their supply of water in closed tanks, the breeding of mosquitoes on board ship no longer went on, and steamships did not carry the disease from port to port. The incubation period of the disease is short, five or six days, and as the voyage from yellow fever ports to the United States was usually longer than that, the danger of its introduction of the disease rapidly diminished.

With the introduction of air travel, the whole situation changed, the duration of the voyage was so shortened that persons could arrive from the yellow fever regions within the incubation period of the disease, and we know that the person who is first taken sick after arrival in Miami might infect the local mosquitoes before any one was aware of the danger. Furthermore, a mosquito in nature probably has a life span of about three weeks, and during that time it can carry the disease up to the last day of its life. The carriage of mosquitoes by airships thus becomes a problem of first importance. I will return to this aspect of the problem later.

The number of cases of yellow fever reported from the regions where it is constantly present is always small, and yet we know that cases must be constantly present or the disease would die out. There must be many mild cases which give no characteristic symptoms, and as a result of field and laboratory studies a method was discovered by which one could reach a decision regarding the diagnosis of mild cases, and we found as a result of extensive studies that most cases of yellow fever are mild; they are diagnosed as headache, malaria, influenza and many other things, yet the protection test, with yellow fever virus, and the patient's blood serum indicated that the patient, no matter how mild the attack, was now immune as a result of a mild infection. This being true an extensive survey was planned of the yellow fever area in the Americas and in Africa. As a result of those studies, it is now possible to draw maps showing the extent of the disease in the two regions. These show that the infection has not occurred in recent years in the United States, Mexico, Central America or on the West Coast of South America. On the other hand, they show that it is still present in the Amazon Valley, particularly the upper valley, and that the region includes parts of Colombia, Ecuador, Peru and Bolivia as well as Brazil. On the African continent, it pre-

vails along the West Coast from Dakar south almost to Portuguese East Africa, and extends inland almost to the borders of Ethiopia. It involves the southern part of Senegal and the Anglo-Egyptian Soudan, and the area extends south to include the upper half of the Belgian Congo.

Both the South American and the African regions, where the disease is endemic, are traversed by air travel routes, and the time of the journey is within the incubation period of the disease. We know, therefore, that the possibility exists of again introducing the disease into Southern Europe and the Southern States, but with this knowledge we can act intelligently and introduce safeguards in air traveling.

Strangely enough, Europe, which has always regarded Yellow Jack as an American disease in which it had no interest, has now become very much alive to the danger, and the Colonial powers and the League of Nations are awake to the need for proper safeguards for air travel from Africa to Europe. In the Americas, the Public Health Service has already taken measures in cooperation with the South American republics to insure safety.

I cite these things to serve as an example of the work which was done by various governments and voluntary organizations in the control of one of the world's most dreaded plagues. Work of this sort, as you see, can and must ignore political boundaries, and the results can only be obtained as a result of understanding between the workers of different nations who all have a common objective, of conquering a plague and providing better conditions for the nationals of many different countries. The work is done by many persons, and of course they all deserve credit, and in a gracious way you have recognized this, in the setting up of the Marcellus Hartley medal, which you have granted me this year, and which I am delighted to accept, with the feeling that in granting it you recognize the merit of the many persons who have shared in the work and that I am merely a symbol for cooperative, scientific effort to improve the condition of mankind through the application to human welfare, of whatever scientific truths and methods that are possible.

Again, Mr. President, I thank you for the honor and for this opportunity of speaking for my coworkers.

FREDERICK F. RUSSELL

ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING OF THE NATIONAL ACADEMY OF SCIENCES

Torsion of rectangular tubes: WILLIAM HOVGAARD. The stresses in tubes subject to torsion are generally determined on the basis of a hydrodynamical analogy first pointed out by Lord Kelvin or by means of a mem-

brane analogy developed by Prandtl. For thin-walled tubes an approximate solution was worked out by Bredt, applying Stokes's theorem. The shearing stresses are conceived to flow in the manner of an ideal fluid as a

steady stream around the tube between the inner and outer contours of the walls. If the walls are of uniform thickness the stresses are the same everywhere except quite locally at the re-entrant corners, and a minor difference exists between the stresses at the inner and outer contours. The experiments described in this paper were made to test the correctness of this theory. Several drawn steel tubes were tested; the angles of torsion were accurately determined and the strains were measured with Huggenberger tensometers. While most of the strains were taken on the external surface of the tubes, internal strains were measured in one of them. The observed angle of torsion was found to be in fair agreement with the theory, but the stresses departed widely from it. Generally, on the external surface of the tubes, there was one maximum at the center line and one near the edges of each wall, all considerably higher than the theoretical stress. The internal strain measurements revealed the fact that along the central part of the sides the shearing stress was much smaller than it should be according to theory, and at points near the sides, but still at a good distance from the re-entrant corners, the stress distribution was very erratic. The most important phenomenon was that breakdown of the tubes occurred when the theoretical shearing stress was still far below the yield point in shearing of the material. It seemed clear that at this low value of the theoretical stress extensive regions of plastic flow must have existed somewhere, probably in the vicinity of the corners. Evidently the theory does not give a true picture of the stress distribution and may lead in certain cases to a dangerous underestimate of the stresses.

Conformal and equilong symmetry: EDWARD KASNER. Conformal transformations preserve or reverse angles and are connected with functions of a complex variable $x \pm iy$, where $i^2 = -1$. Equilong transformations preserve or reverse distances and are connected with functions of a dual variable $u \pm jv$, where $j^2 = 0$. If we are given any analytic curve C , there is a unique reverse conformal transformation S , which leaves fixed the points of C , and also a unique reverse equilong transformation S' , which leaves fixed the lines of C . We define S as conformal symmetry (or Schwarzian reflexion), and S' as equilong symmetry (a new operation). When C is given the direct construction of S' is easy (by means of ordinary symmetry in the parallel tangent lines); but the real construction of S is extremely difficult and is accomplished in this paper by successive approximations using the normals to the curve and the curvature and higher derivatives of the curvature of all orders.

By means of S and S' the bisection of a given curvilinear horn angle is defined in two distinct ways, thus giving a unique conformal and a unique equilong bisector. In the latter case all the metric invariants take values midway between the given values; in the former case this is true only for the first three invariants. In each case the two sides of the angle are symmetric with respect to the bisecting curve.

The groups generated by all symmetries are discussed for both theories. Thus the decomposition of complicated

conformal and equilong transformations into a finite number of symmetries is accomplished. (For the conformal theory see *Amer. Jour. Math.*, vol. 38 (1916) pp. 177-184.)

Abstract equilibrium theory: MARSTON MORSE. Questions of the nature and existence of equilibria are to be found in economics, biology, physics and mathematics, the latter discipline abstracting and completing ideas that arise in the other fields. In economics in particular there has been much confusion in the formulation of the basic problems. One finds equilibrium defined as stable equilibrium, ignoring the fact that in general there are at least as many different kinds of equilibria, that is, many different types of stability and instability as there are variables involved. In historical physics there has been an almost mystical preference for principles of least action, the minimum representing one of types of stability, but there has not been a clear-cut analysis of equilibria in general and a recognition that the so-called minimum principles are in general not effectively associated with minima. By studying equilibria both locally and in the large, the author has developed a theory which is bound to be one of the principal tools of non-linear analysis of the future. A problem proposed by Poincaré in connection with his studies in celestial mechanics, but not solved by him, has been solved by a use of the author's theory. The present studies of the author are in the direction of universalizing his methods. Various other names might be applied to these studies—"Analysis in the large," "Functional Topology" and, in particular, "Calculus of Variations in the large." The results now available enable one to work with curves and configurations in general as if they were point elements in an abstract space and have one set of principles applicable to all. Group theory is the bone, topology the flesh and analysis the superficial exterior in the composition of this theory.

On the problem of stability in dynamics: GEORGE BIRKHOFF. It has been shown by the author that the general formally stable motion of a dynamic system is either ultimately unstable or is surrounded by an infinite succession of zones of instability. In the present paper the author gives further reasons leading to the conclusion that the general case must be that of actual instability. If this conclusion be applied to an idealized solar system it would mean that ultimate instability is highly probable. However, this instability would only arise after enormous lapses of time.

Problems of closest approximation in two variables: DUNHAM JACKSON. In papers read before the American Mathematical Society the writer has presented theorems specifying upper bounds for the magnitude of polynomials and trigonometric sums normalized with respect to a given weight function, and corresponding inequalities relating to the approximate representation of functions of a single real variable. The present paper contains results of similar character for functions of two variables. While the extension is immediate in some of its aspects, it also introduces new considerations which

the problem in two variables a degree of interest for its own sake.

Equilibrium between excitation and ionization in a high pressure discharge: FRED L. MOHLER (introduced by W. Coblentz). Measurements of intensities of line emission spectra and of reversal temperatures of absorption lines in a columnar cesium discharge show that at pressures above 70μ the population of all states of the S, P, D and F series beyond the second or third term have a temperature distribution. On the basis of the intensity of the continuous spectrum and probe measurements under low pressure conditions one can obtain values for the number of ions and electrons per cubic centimeter in the discharge at higher pressures. Substitution of these numbers in Saha's equation gives a value of T which comes out to be the same as the reversal temperature and for higher series lines under the same discharge conditions. There is evidence that probe measurements are systematically in error at high pressure.

Scattering of slow neutrons: ALLAN C. G. MITCHELL (introduced by S. A. Mitchell). Fermi has shown that neutrons which have been slowed down by collisions with hydrogen nuclei, in substances such as paraffin, have a greater probability of being captured by certain atomic nuclei such as boron, cadmium and silver than fast ones. Others have measured the absorption coefficients of slow neutrons in various substances and found large variations in atomic absorption coefficient from one element to the next. To decide whether the large absorption cross sections determined in these experiments are due to capture of the neutron or to scattering we have measured the scattering of slow neutrons from some thirteen elements distributed throughout the periodic table. The experiments give the relative scattering cross-section and also some indication as to the ratio of scattering to capture. We have shown that, for those elements exhibiting anomalously large absorption coefficients, the probability of capture is great and that of scattering is small. This is in agreement with the original theory proposed to explain the large capture cross-sections, but is in agreement with the more recent theory of Breit and Wigner. Finally, evidence has been found for selective absorption and scattering for the different groups of neutrons found by Fermi.

The transmutation of platinum by deuterons: E. O. LAWRENCE and J. M. CORK. One of the noteworthy results of recent investigations in our laboratory is the production of radioactive forms of many of the elements throughout the periodic table, by bombardment with five million volt deuterons. Platinum was chosen first for careful study because of its chemical properties, which are favorable to the reduction of contaminating effects. Chemical separations of the elements in the bombarded platinum targets showed that radioactive isotopes of both iridium and platinum are formed. Radio-iridium probably is the product in a reaction in which the deuteron is captured by the platinum nucleus and an alpha particle is emitted. On the other hand, the production of radio-

platinum involves only neutron capture. The transmutation function, i.e., the probability of the nuclear reaction as a function of the energy of the bombarding deuteron, exhibits several maxima and these are interpreted as evidence of resonance penetration of the deuterons into the platinum nucleus.

Systematic determination of wave-lengths and intensities of the spectral lines of the chemical elements: GEORGE R. HARRISON (introduced by K. T. Compton). The analysis of complex atomic spectra has been retarded by an insufficiency of accurate data on the wave-lengths and intensities of the lines emitted by the chemical elements. Several million measurements on more than a million spectrum lines in the range 10,000 to 200 Angstroms are needed, accurate to 1 part in 5,000,000 or better as to wave-length, and with objective intensity determinations. A comprehensive program is now under way with these ends in view, utilizing recently developed automatic wave-length measuring, computing and recording machinery which expedites the obtaining of data by from 20 to 200 times, and increases accuracy several fold. More than 3,000 twenty-inch spectrograms, at dispersion of 0.4 Å/mm, of the spectra of the more complex atoms have already been obtained and measured. Thirty-four foot and 21-foot Wood concave gratings are being used in the air and vacuum regions, respectively, both having 30,000 lines per inch. The wave-lengths and intensities, which are recorded directly on motion picture film by the machine, are being tabulated, correlated and averaged by a staff of 60 WPA workers. Wave-length data on any elements will be supplied as obtained to any qualified investigator wishing it for analysis of spectra. It is desired to check as many of the wave-lengths as possible by the combination principle before publication.

New radioactivity detection technique applied to the study of radium poisoning: ROBLEY D. EVANS (introduced by J. C. Slater). Radium poisoning is the result of the fixation in the human skeleton of one or more micrograms of radium, following intravenous injection or oral administration of radium or other radioactive salts. The physical problems involve the determination of the total amount of radium fixed in the skeleton and of the actual amount of radium removed from the skeleton by treatment. That part of the body radium which yields radon expired in the breath is determined by emanation analysis of the breath. The remainder, and larger fraction, of the body radium disintegrates *in situ* into lead and, in passing through the radium C state, emits penetrating gamma radiation. This gamma radiation from the body is accurately measured by the use of a new type of screen-cathode quantum counter, which is from 10 to 100 times as sensitive as the electroscopes formerly employed for such tests. The instrument has detected radium in at least one fatal case, which had been erroneously reported as negative by repeated electroscopic tests elsewhere. This increased sensitivity also permits measurements at a distance of a meter or more from the patient. Under these conditions geometrical simplifications permit the direct determination of the radium C in

the patient, without the use of an artificially activated cadaver or of post-mortem analysis of previously measured victims, for calibration purposes. The amount of radium removed from the patient by treatment is determined by direct analysis of the feces and urine, either by the radon technique with double ionization chamber detection or in some cases by direct gamma ray analysis with quantum-counters. In collaboration with Dr. J. C. Aub, of the Huntington Memorial Hospital, Harvard University, extensive studies of a typical case of radium poisoning have been made, and a treatment developed which has given interesting results. These will be briefly discussed. The development of the quantum-counters used in this investigation is supported by a grant from the American Philosophical Society.

Changing direct current to alternating current by means of thyratrons: ALBERT W. HULL. The use of direct current rather than alternating for transmission of electric power has many well-recognized advantages, but has been considered impractical for lack of a satisfactory method of changing the high voltage direct current into alternating current at the end of the line, for distribution to customers. The Research Laboratory of the General Electric Company has, for several years, been studying the application of thyratrons to this problem of changing direct current to alternating current. The study has progressed to the point where its scientific aspects may be reported. Although our developmental studies included the use of constant voltage, it was found that the problem, at least for the present, could be greatly simplified by using electric circuits which maintain *constant current* in the line, allowing the voltage between line and ground, rather than the current, to vary with load. A short-circuit under these conditions reduces the flow of power and does no harm to either tubes or circuit. This type of circuit not only facilitated research, by making it permissible to produce failures at will in order to study their effects; but proved to have many practical advantages. An extensive study has been made of the mutual effects of tubes and circuit. One of the most important discoveries is a circuit condition such that inverter tubes will immediately resume operation, generally within one cycle, after a failure of either tubes or circuit. Circuit conditions for high voltage operation have been investigated. It is found that the maximum voltage at which tubes will operate is inversely proportional to the current which they carry. With the tubes available at present, this limit is 15,000 volts at 200 amperes. A rectifier unit using twelve such Phanotron tubes is required, to change 200 amperes of alternating current to 200 amperes direct current at 30,000 volts; and a similar unit using twelve Thyatron tubes to change it back to alternating current. The tests indicate that the voltage of this unit may be doubled, trebled, etc., by using two, three, etc., tubes in series in place of one; and that the units themselves may be connected in series to give any desired voltage. The life of tubes is found to depend upon the circuit, which determines the velocity, and hence the destructiveness, of impacts of positive ions upon the anode. Circuit condi-

tions have been found which minimize this effect, and promise a tube life of adequate length.

Cosmic rays at high altitudes on two sides of the world in the equatorial belt: R. A. MILLIKAN, H. V. NEHER and SERGE KORFF. Automatic Neher recording cosmic-ray electroscopes have been carried in a considerable series of flights made on both sides of the earth, one group in Peru, the other in Manila, up to altitudes some of which reach two thirds of the way to the top of the atmosphere. In Peru in a latitude only a degree removed from the magnetic equator at an altitude of 29,000 feet, where the pressure is but 3.3 meters of water, or 32 per cent. of its sea-level value, the ionization within a closed electroscopical volume at 1 atmosphere is 18 times its value at sea level and amounts in absolute measure to 49 ions per cc per second. In Manila, in essentially the same magnetic latitude, it is practically the same—a few per cent. lower on account of the longitude effect. This longitude effect is certainly no larger—as measured in percentage—apparently somewhat smaller at these high altitudes, than at sea level. On both sides of the earth in the equatorial belt the ionization rises essentially exponentially with altitude, the apparent coefficient of absorption being $\mu = 0.50$ per meter of water. The only notable difference between the curves picturing the ionization as a function of altitude in the equatorial belt as contrasted with the same curves in the temperate and polar zones up to these altitudes is that in the latter zones the apparent coefficient of absorption is $\mu = 0.55$ per meter of water instead of $\mu = 0.50$ per meter of water, its value in the equatorial belt. These facts remove the most cogent arguments that have recently been used for the assumed great predominance of the electronic over the photonic component of the cosmic rays as they enter the earth's magnetic field. In the present state of our ignorance, however, they do not in themselves entirely remove the possibility of assuming, as some have wished to do, that the incoming rays consist only of charged particles. They merely render this assumption one of considerably less probable validity.

Preliminary study of temperature effects of short solar fluctuations: C. G. ABBOT. Solar radiation stations 7,000 miles apart in opposite hemispheres agree, indicating day-to-day changes of the sun's output of radiation. These fluctuations frequently fall in sequences of several days' duration, when the sun's radiation increases or decreases. The range of such changes is seldom greater than 1 per cent. All such occasions, indicated as of fair probability of reality in the years 1924 to 1930, inclusive, were selected from the recorded solar constant observations of the Smithsonian station at Montezuma, Chile. The departures of temperature from the normal at Washington from the initiation of each such solar change till 16 days thereafter, have been tabulated. These departures are computed from recorded means of maximum and minimum temperatures. It was expected that if real temperature changes were disclosed by the tabulation, they would be in opposite senses depending on whether the solar sequences were rising or falling. It was also expected that if real temperature effects were disclosed the

would vary with the season of the year, because the atmospheric paths followed by meteorological disturbances are changeable. Accordingly, tabulations of the temperature march were made for each month of the year separately, and separately for rising and falling solar radiation sequences. The results are shown in slides. They show that the solar variation is a major weather factor. They indicate a real opposition of temperature marches for all months of the year. The effects are surprisingly large. They are of the order of 5° F. at maximum for 0.5 per cent. change in solar radiation.

Periodogram analysis of rainfall of the Pacific Coast:

DINSMORE ALTER (introduced by Robert J. Trumpler).

The present paper discusses briefly the methods of periodogram analyses and applies one of these to the rainfall of two sections of the Pacific Coast. It is the first of a series in which, in so far as data are available, the coast will be examined from Alaska to the Canal Zone. The sections examined here are western Washington and the northern third of California. Only stations west of the foothills of the Coast Range have been included. The results show very definitely cycles of such length that it is impossible to discard an hypothesis of solar influence. In western Washington a fundamental cycle of 220 months is exhibited with its third harmonic very strong. When divided into thirds, the periodogram shows that the minor maxima match excellently and indicate that a short cycle has been continuously present in addition to the long cycle. For northern California the periodogram is more striking than in the former case, both in regard to the amplitude of the cycle that is found and the regularity of the pattern exhibited. The author believes the results to be incapable of interpretation as accidental, but wishes to stress the fact that at present they have no economic application. Any solution of the problem of long-range forecasting is in the future.

Periodic departures of the motion of minor planets of the Hecuba group from prediction with the Berkeley tables of perturbations:

A. O. LEUSCHNER, SOPHIA H. LEVY, CLAUDE M. ANDERSON and BARBARA P. RIGGS.

Contrary to expectation, observations of the minor planet (175) Andromache in the 1935 opposition showed large departures from the positions predicted on the basis of mean elements and perturbations based on the Berkeley tables. The elements used were the original mean elements derived with the tables from Berberich's elements osculating in 1877 after their correction by a least squares solution on the basis of oppositions extending from 1894 to 1907. A study of the available comparisons between theory and observation from 1877 to 1935 on the uncorrected mean elements and tables revealed that the planet departed from prediction periodically, the period of variation being that of the planet. After introducing the necessary additional terms in the perturbations of Andromache, the discrepancies were removed. The question arose as to whether the departures were peculiar to Andromache for which the heliocentric perturbations in mean anomaly have undergone so far a change of nearly 50°, the largest hitherto encountered, or whether they are

inherent in the tables. A study of the departures for other minor planets of the Hecuba group shows similar periodic departures, though less pronounced, depending in magnitude on the perturbations themselves. It is, therefore, evident that the Berkeley Tables of perturbations for the Hecuba group have to be extended to include terms which hitherto have been considered inappreciable. For the present the necessary correction of the perturbations is being made empirically for individual planets, without correcting the original elements. This investigation demonstrates that elements should not be corrected unless all appreciable perturbations have been taken into consideration.

Selective absorption of starlight by interstellar clouds:

FREDERICK H. SEARES.

The colors of 454 stars, mostly between magnitudes 10 and 13.5, have been studied from the standpoint of selective absorption produced by interstellar clouds. The stars are in 30 different fields (Selected Areas of Kapteyn), covering a wide range in distance from the Milky Way. The criterion for selective absorption is an excess of color over that inferred from the spectral types of the stars (stars redder than normal). The observed colors (color indices) were obtained from photographic and photovisual magnitudes, all on the international system; inferred colors were derived from a relation between color index and spectral type established for regions far from the Milky Way and hence but slightly affected by absorption. The mean values of the color excess for groups of eight or ten stars show the following characteristics: (1) All fields within the zone of avoidance for extra-galactic nebulae or in regions of partial obscuration as outlined by Hubble's counts of nebulae (15 fields in all) include groups of stars showing a conspicuous color excess. (2) Eight fields beyond the well-marked region of partial obscuration also show color excess, smaller in amount but in most cases apparently definite. A sporadic region of low nebular density occurs within a few degrees of each of these fields. (3) Nineteen fields include stars which are normal in color: 8 are the fields referred to in (2), 7 are unobscured, 2 are partially obscured and 2 are within the zone of avoidance for extra-galactic nebulae. (4) Fields showing an excess of color often include stars that are normal. For example, 12 of the 23 fields under (1) and (2) also occur in (3). (5) The mean color excess for 185 stars in 23 fields is 0.5 mag., with a maximum of 0.8 mag. for a group of 13 stars in Selected Area 40, midway between α Cygni and the North America Nebula. Ninety-nine additional stars in 10 of these fields show a mean color excess of 0.2 mag. The average color excess for the 19 groups of normal color (170 stars) is ± 0.05 mag. (6) Color excess increases as the galactic latitude of the fields decreases, but the data are too scanty to justify a discussion of the relation of color to either latitude or longitude. Closely related to the foregoing results are the following: (a) For color indices on the international system the zero point of the relation between color index and spectral type is such that for A0 stars in unobscured regions the color index is -0.14 mag., with an uncertainty of perhaps 0.03 or 0.04 mag. (b) For 271 stars north of 80° declination

(Draper Catalogue spectra) the spectrum-color relation gives for A0 a color index of -0.04 mag. (c) Comparison of (a) and (b) indicates for the brighter stars within the polar cap (galactic latitudes 18° to 38°) a mean color excess of approximately a tenth of a magnitude. The region includes dark nebulosity and is deficient in extragalactic nebulae.

Results of the Yale photographic meteor work, 1893-1909: CHARLES P. OLIVIER (introduced by Frank Schlesinger). The study of meteors by photography was carried on for a long period at Yale Observatory by Dr. W. L. Elkin. Much of the material had been reduced by him when his failing health intervened. By mutual agreement both data and computations were turned over to C. P. Olivier in 1922 for discussion and completion. This paper presents the results. Elkin devised and successfully used apparatus for photographing meteors. By having two stations occupied, he obtained simultaneous observations which permitted accurate determinations of the meteor's radiant and heights in our atmosphere. From plates made with a rotating wheel in front of the camera, the linear velocity of the meteor at different heights could be determined, and its actual orbit in space could be computed. About 125 trails were recorded, and measurements of them were made with a high degree of accuracy. The calculations of heights, velocities and radiants were only partly carried out by Elkin before ill health forced him to stop work, and he was unable to undertake a general discussion of results. Olivier undertook to finish the computations, and then to extend and discuss the results in view of advances made in meteoric astronomy during the intervening thirteen years. Methods were devised to test both the accuracy of the data and the suitability of Elkin's formulae for the purposes for which they were employed. Some of the results were made more concordant by handling the data in a different manner. Elkin's work, excellent in general plan, was by far the best of its kind completed up to 1909, and in fact it has not yet been equaled. A number of valuable results have been derived from it. It would have been more successful had the stations been farther apart, and it is now obvious that the plates were measured with a higher degree of accuracy than the average trail permitted. These and other facts lead to a partial modification of some of the widely-quoted tentative conclusions published by Elkin in 1900 on the basis of the earlier data. A similar program carried out in a clearer climate, with modern cameras, would yield results of great importance.

The underlying causes of submarine canyons: FRANCIS P. SHEPARD (introduced by William Bowie). Investigations of submarine canyons carried on for a number of years with the cooperation of the Coast and Geodetic Survey, the Geological Society of America, Scripps Institution and other organizations have revealed that these sea-floor canyons have all the characteristics of river canyons and are distinctly different from fault valleys. Also tests of the idea that the submarine canyons might be the product of currents have produced negative results so that they have evidently been cut by rivers. The significance of this sub-aerial erosion on the present sea

floor is particularly disturbing, since the submarine canyons extend out to depths of from 2,000 to as much as 10,000 feet and are found off practically every coast of the world. Also all available evidence favors a Pleistocene age for the canyons. Accordingly, there is the implication that the coasts of the world were greatly elevated above their present positions during the glacial period. That all the continental margins both off stable and unstable coasts could have been subjected to such movements in comparatively recent times is scarcely credible. The alternative that there have been sea-level changes connected with the cause seems much more reasonable. Such changes are indicated not only by the submarine canyons but also by many of the phenomena of coral reefs and by oceanographic data from various parts of the world. The only cause of sea-level change which does not meet with almost insurmountable objections is that of glacial control. It seems quite possible that the continental glaciers during some of the earlier glacial epochs may have been sufficiently thick and sufficiently extended to have allowed a lowering of 3,000 feet or more. While such a lowering was probably insufficient to account for the deeper canyons it is felt that it would have resulted in the development of a universal canyon system which, connecting with much older sunken canyons in some places and modified by subsequent sinking elsewhere, would account for the present situation.

Correlation of erosion surfaces in southwestern Wisconsin: DOUGLAS JOHNSON and ROBERT E. BATES. The upland of southwestern Wisconsin, excluding the Baraboo region, consists of a submaturely dissected plateau underlain by Paleozoic formations that dip gently southward. It is characterized by numerous broad, flat summit areas, limited to the crests of cuestas and the principal divides, and by more extensive flat areas at slightly lower elevations between the cuesta crests and along the larger streams. Geologists have differed widely in their interpretation of these forms, some holding that two peneplane surfaces are represented, others recognizing but one, while still others find stripped surfaces of resistant formations but no peneplane surface. Projected profiles¹ of the region show that the crests of the three cuestas developed on the Prairie du Chien, the Platteville-Galena and the Niagaran are distinctly beveled by the broad, flat summit areas. These areas are, therefore, interpreted as peneplane remnants. Most of the lower parts of the upland coincide with the structure to such degree that they seem better interpreted as stripped structural surfaces rather than as peneplane remnants. Since all the areas beveling the structure can be included in one surface of low relief, it is concluded that one peneplane, but only one, the Dodgeville, is required to explain the present topography. This conclusion is of interest in connection with studies of Appalachian erosion surfaces which seem to demonstrate the existence of (1) one major peneplane of Tertiary age (the Schooley peneplane), (2) parts of several resurrected peneplanes of more ancient date, and (3) two or possibly three partial peneplanes of late Tertiary or

¹ Made possible in part by a grant from the Marsh Fund of the National Academy of Sciences.

subsequent date. Definite correlation of the Dodgeville peneplane in southwestern Wisconsin with its correlative in the Appalachian area must await further study. In the meantime we observe that results of the Wisconsin study, like those carried out in the Appalachians, confirm former wide-spread base-leveling, but are opposed to the indefinite multiplication of erosion cycles advocated by some investigators.

The system, albite-fayalite: N. L. BOWEN and J. F. SCHAIRER. The study of the system, albite-fayalite, is a first step in the investigation of phase equilibrium in mixtures of alkali aluminosilicates with ferrous silicates. The system is of the simple eutectic type, the eutectic composition at 84 per cent. albite and its temperature $1050^{\circ} \pm 5^{\circ}$ C. Albite, that most reluctant of crystallizers, readily forms typical twinned crystals in mixtures of this system. Among natural rocks fayalite trachytes and related types (fayalite-bearing rocks rich in albite) are of wide-spread occurrence, though not abundant, and the investigation of which this is a part is designed to throw light upon the thermodynamic properties of these mineral associations and upon the problem of their genesis. In connection with the hypothesis of their derivation through fractional crystallization the albite-rich character of the eutectic is of particular significance.

Stolon-systems of communication between the equatorial chambers of orbitoid foraminifera: T. WAYLAND VAUGHAN. The orbitoid foraminifera range in age from Upper Cretaceous to lower Miocene and are of much value in solving problems of geological correlation. Their tests are composed of three layers of chambers, a median or equatorial layer, on each side of which there are lateral chambers, usually more numerous over the center and less numerous toward the periphery. There are no canals. The roofs and floors of both the equatorial and lateral chambers are pierced by cribriform perforations and there are stolons through the walls between chambers. The arrangement of the stolons connecting the equatorial chambers presents different plans which apparently are of phylogenetic and taxonomic significance. These features can now be readily studied by a method of impregnation with Canada balsam, with subsequent decalcification, developed by Hofker. Although it would be premature to claim that all the systems of the stolon-communication between the equatorial chambers have been recognized, the following may be enumerated: (1) Four-stolon system: Stolons at two places on each side of each chamber (recognized by H. Douvillé in *Orbitoides*, and by Whipple, Vaughan, and van der Geyn and van der Vlerk in other genera and subgenera). (2) Stolon system rather indefinite: Three, four or more stolons between chambers, some of them through the lateral walls of the chambers, others radial in position. Example, *Clypeorbis mamillata* (Schlumberger), for which I have recently established the presence of stolons. (3) Five- or six-stolon system: Stolons as in number 1, but with a radial stolon through the proximal or the distal wall of a chamber or through both walls. This system when complete is a six-stolon system. I have just found this arrangement in two species

of *Helicolepidina*. The presence of radial stolons in *Poly-lepidina proteiformis* Vaughan suggests that similar stolons may occur in other genera and subgenera classified under number 1. (4) Six-stolon system: Two oblique stolons passing through the chamber walls at four places and an annular stolon passing through the chamber walls at two places. This arrangement was worked out in *Lepidocyclina mantelli* (Morton) by Carpenter and published in 1862. Recently Whipple, Tan Sin Hok, van de Geyn and van der Vlerk, and I have added other species to this category. I have just found that in both the Upper Cretaceous species *Lepidorbitoides socialis* (Leymerie) and *Lepidorbitoides minor* (Schlumberger) there are six stolons. (5) Eight-stolon system: Similar to number 4 but with a radial stolon across both the proximal and the distal chamber walls. This arrangement has just been found by me in *Lepidocyclina yurnagunensis* Cushman. (6) The stolon systems of *Miogypsina* and *Miolepidocyclina* have also been studied, but as these genera probably should be removed from the Orbitoididae, they will not be considered here. As a result of studies of the stolon systems of the Orbitoididae changes in the classification of the foraminifera referred to that group appear to be necessary, and such changes are now under consideration. Names proposed by van de Geyn and van der Vlerk to replace earlier names proposed by H. Douvillé and myself are invalid.

The helium method applied to Pre-Cambrian chronology problems: WILLIAM D. URRY. In collaboration with the National Research Council Committee on the Measurement of Geologic Time, the radioactive disintegration helium method has been applied to the basic igneous rocks. In the helium method the accumulating end-product, helium, is measured in place of the lead in the more familiar lead method. A post-Keweenaw to Pliocene geochronological scale set-up from some sixty results by the helium method is found to be in general agreement with the lead method results and ages on the basis of sediments. The helium method has the advantage of applicability to all fresh basic igneous rocks, with a possible extension to other types of rocks, compared to the sporadic occurrence of radioactive minerals necessary for lead method determinations. The question now arises as to how far the method can be applied to the Pre-Cambrian rocks. To test such an application, the geochronological sequence in the Horne mine, Noranda, Quebec, has been studied from the latest dikes in the area, now correlated with the Keweenaw on the basis of the helium method, to the Keewatin Andesite. Similarly, the Sudbury Nickel Irruptive is placed in the middle Keweenaw, and with a dating of the fresh olivine diabase dikes in the Sudbury area it should be possible to determine the chronological position of the Killarnean Revolution more accurately than is known at present. Other terrains studied which indicate the applicability of the method to the Pre-Cambrian are the Huronian Gogebic Range in Northern Michigan, the Beltian and the Great Bear Lake region. It is concluded that the method can be applied to the Pre-Cambrian terrains at least back to the Keewatin.

The hot spring problem in Yellowstone Park: ARTHUR L. DAY. The problem of the Yellowstone hot springs is intimately related to earlier volcanic activity. We are concerned to-day with the origin of the continuing heat supply, the origin of the water supply, the water circulation, the magmatic gases and their corrosive action upon the rocks, the age of the geysers and the theory of their operation, and finally, what mineral matter is deposited and what is carried away by the circulating water. The studies which will be described have covered a period of seven years, including four winter seasons. The geysers do not "freeze up" in winter, even at temperatures of 40° or more below zero. They continue in action with little change in heat or volume of water, though the surrounding country may be covered with 6 to 10 feet of snow. During this period a new geyser of magnificent proportions (since named the Imperial) has burst forth, has erupted twice daily for more than a year with an immense volume of water and then has suddenly died out and become again a quiet warm spring. Also, for the first time in Yellowstone Park, two borings have been made for information of the actual conditions below ground. In one of these a temperature of 205°C. and a steam pressure of more than 300 pounds was developed at a depth of 250 feet. This indicates an enormous store of energy. Dissolved mineral matter carried away daily amounts to as much as 390 tons, although no more than 5 per cent. of Yellowstone Park water is hot.

The quantitative index of resemblance in geographic distribution: HARRY H. LAUGHLIN (introduced by A. F. Blakeslee). In its simplest and most useful form a correlation index is a single value, less than 1.0000, which measures the degree of resemblance between two sets of measured qualities in one set of individuals or between two sets of individuals in reference to one measured quality. When such resemblance is very high, if the index is properly based, the correlation measure approaches 1.0000; it reaches 1.0000 when the statistical interdependence is perfect. When there is absolutely no such interdependence, other than that caused by chance, the measure of correlation equals 0.0000. When measured correlation runs high the investigator is justified in looking for causal relationships. Thus the coefficient or index of correlation is a very valuable tool in research. But the basic thing in statistical correlation is measure-distribution among individuals of a given class regardless of their place-relationship. Hence, the coefficient of correlation does not cover the field of resemblance in geographic or geometric distribution. As the geographical sciences become more exact the demand becomes more pressing for an index with which to measure the degree of resemblance in the geographic or geometric distribution of measurable qualities. The present purpose is to devise such an index, based on sound principles, and made available for use in the geographic and geometric aspects of definite problems in different fields of investigation. This problem and its proposed solution were stated.

Interspecific hybrids involving factors for ascus abortion: B. O. DODGE.

*A method of isolating tertiary $2n+1$ forms in *Datura* from prime types by use of double half chromosomes:* A. F. BLAKESLEE, A. G. AVERY and A. D. BERGNER. Prime Type 4, which is a race from nature, has the chromosomes 3·21 and 4·22 in place of the chromosomes 3·4 and 21·22 of our standard Line 1. The form $2n+4·22$ frequently appeared in offspring of parents heterozygous for PT 4, but the form $2n+3·21$ did not appear under similar conditions, although large plantings were made to secure it. It was finally obtained by the following procedure. A secondary $2n+3·3$ was rendered homozygous for PT 4 by continued back-crossing to the latter as the male parent. Secondaries regularly throw their primaries and therefore, among the offspring of the homozygous $2n+3·3$, a $2n+3·21$ appeared through segregation. This was a primary $2n+1$ form of PT 4. By back-crossing to the standard Line 1 it can be rendered homozygous for the 3·4 and 21·22 chromosomes and thus become a tertiary form of our standard line.

Chimpanzee metabolism: FRANCIS G. BENEDICT and JOHN M. BRUHN.

Studies on the body temperatures of elephants: FRANCIS G. BENEDICT and ROBERT C. LEE. It is impracticable to measure the rectal temperature of the elephant. An index of its body temperature can be readily obtained, however, from temperature measurements of the large volumes of urine and feces periodically discharged. These excretory products are residual within the abdominal cavity for some time before discharged and hence must assume the body temperature. Measurements of urine temperatures of 45 adult, female, Indian elephants showed a variability of about 1° C., and an average of 35.9° C. The urine was collected in a wide-mouthed thermos jar, previously warmed with water at 37° C. The measurements were made with an ordinary clinical thermometer within one minute after collection of the urine. Feces temperatures were determined immediately after defecation, by inserting a thermometer 3 cm. into the bolus, leaving it there for half a minute, pushing it in another 3 cm. and recording the maximum reading. Records thus obtained averaged 0.7° C. higher than the urine temperature, a difference explained by the fermentation processes still going on in the feces. A practical method of determining the elephant's body temperature is, therefore, to take the feces temperature as indicated and deduct 0.7° C. from the reading. If the result differs much from 35.9° C., additional feces temperatures should be taken to establish the real difference. As the elephant defecates 14 or 15 times daily and can frequently be stimulated to defecate by suggestion, this method of measuring body temperature presents no difficulty.

Development of the cells of the blood and bone marrow in the rabbit: FLORENCE R. SABIN. Studies of the blood cells of young rabbits show that the red cells increase at a different rate from the white cells. During late fetal stages, the number of red cells is low, but, as was known, each cell has a high content of hemoglobin. Thus the fetus has an adequate mechanism for the elaboration of

hemoglobin, but not for the multiplication of the red cells. At birth the marrow is relatively inactive, but by the fifth day it has become hyperplastic with erythroid elements. Thus, after the animal has begun to eat, adequate numbers of red cells are readily produced. The number of red cells per cubic millimeter of blood characteristic of the adult animal is reached during the second and third weeks of life. The high proportion of hemoglobin per cell is not completely reduced until the third month. The white cells increase for the most part more slowly and reach their full quota only by the fifth and sixth months of life. The monocyte is an exception to this, for it increases rapidly to its final number per cubic millimeter during the first week. During the first month, while the bone marrow is predominantly erythroid, the major group of the granulocytes, the pseudo-eosinophiles, does not increase in the peripheral blood. During this month, on the other hand, the lymphocytes increase rapidly. For the next four months granulocytes and lymphocytes increase slowly and at the same rate.

*Second attacks and reinfection in poliomyelitis:*² SIMON FLEXNER. A characteristic of virus diseases, of which poliomyelitis or infantile paralysis is a notable example, is that an attack leaves the recovered individual protected from a subsequent infection. The rule is not, however, absolute and exceptions occur in many, if not all, kinds of virus diseases, not excepting poliomyelitis. Despite the worldwide prevalence of infantile paralysis during the past twenty-five years, in which many thousands of children were paralyzed, the number of instances of second attacks recorded in the literature is very small. Perhaps a dozen such cases have been reported which, at best, must be a fraction merely of those having occurred. The phenomenon is an important one from both practical and theoretical considerations. The manner of infection in poliomyelitis is peculiar in that the virus, which enters the body from the nose, uses the nerve of smell exclusively in order to reach the brain and spinal cord. In following this nerve route, the virus avoids coming into direct relation with the protective blood immunity substances which are developed in man and the monkey from an attack of the disease. There are difficulties surrounding the detection of undoubted second attacks of infantile paralysis in human beings. No such difficulty exists in respect to monkeys. Hence the manner in which these second attacks arise can be most completely studied in the disease as experimentally induced in monkeys. Old World monkeys are subject to inoculation with the virus of poliomyelitis dropped into the nose, which then passes to the central nervous organs by way of the nerves of smell and produces in the animals pathological effects, attended by symptoms corresponding to those present in persons attacked by the disease. When the monkeys recover from an experimentally induced infection, they are comparable to human beings who have recovered from the disease. In addition, monkeys can be rendered actively immune by repeated, subinfective injections of the virus of poliomyelitis. These animals are comparable in resistance to

those which have recovered from actual infection. Also, the artificially immunized monkeys can be secured for study in any convenient numbers, while the recovered or convalescent animals can be assembled but slowly. Monkeys which have passed successfully through mild and severe attacks of poliomyelitis, or been actively immunized, have been subjected to the reinstallation of the virus into the nose, and the effects have been studied. The first indication of infection can be detected in the cerebrospinal fluid, where cellular and chemical changes occur. This delicate index enables the experimenter to follow the action of the instilled virus from the first influence through the subsequent events, which may or may not lead to a typical second, paralytic attack of the disease. The response of these recovered monkeys to virus strains of different origins and of varying activity or virulence can thus be determined, as can be the existence of a durable or only partial and passing immunity in the animals previously affected.

Effectiveness of various wave-lengths of ultraviolet light in experimental rickets: JOHN W. M. BUNKER and ROBERT S. HARRIS (introduced by V. Bush). Work reported at the Spectroscopy Conference at M. I. T. in July under the title "Precise Evaluation of Light Therapy in Experimental Rickets" has not been published, but has now been refined and brought to a satisfactory precision for a report. Lines 3025, 2967, 2804, 2650, 2537 Angstroms have been evaluated in terms of the ergs of each required to duplicate a definite degree of recovery from standardized rickets, standardized in terms of the International Units of Vitamin D required for test healing. Energies have been measured by both thermopile-galvanometer and by Louis Harris Chemical Actinometer method. Line 2967 is twice as efficient erg for erg as 3025 or as 2537. More than twice the ergs necessary for these latter two lines if applied in wave-length 3150 or 2480 give absolutely no healing.

Phytopharmacological reactions of normal, toxic and atoxic blood sera: DAVID I. MACHT and RAYMOND E. GARDNER (introduced by D. H. Tennent). Phytopharmacological studies begun by the senior author fifteen years ago revealed that many drugs and chemicals affect plant tissues more profoundly than they do living animal preparations. In this way was made the first demonstration of certain toxins in the blood, not detectable by animal experiments or physico-chemical methods. The simplest quantitative technique for such studies consists of determination of root growth of *Lupinus albus* seedlings in physiological solutions under uniform conditions of nutrition, light, temperature, etc. Normal blood sera of many genera of animals were found to have the same phytotoxic index as human beings; that is, about 75 per cent., as compared with the reading given by normal controls grown in plant-physiological saline (Shive). The only exception was the blood sera of reptiles (turtles, alligators, lizards, gila monsters and snakes), which were more toxic than those of other cold-blooded animals. Blood serum of "non-poisonous" snakes was as toxic as that of poisonous serpents. From a physiological point of view a most interesting finding was a demonstration in the

² From the laboratories of The Rockefeller Institute for Medical Research, New York City.

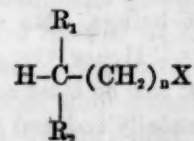
blood and other secretions of menstruating women of the presence of a toxic substance absent in the intermenstrual period. Of pathological and diagnostic value were the findings obtained in studies on bloods from several grave diseases: pernicious anemia, pemphigus and leprosy. Such sera revealed marked and specific degrees of toxicity, useful in establishing a differential diagnosis and offering criteria for evaluation of therapeutic procedures. Phytopharmacological examination of pernicious anemia blood sera revealed that liver treatment, while increasing the blood count, did not detoxify the serum. Phytopharmacological examination of over two thousand sera from various dermatoses proved conclusively the remarkable reliability of the phytotoxic reaction in establishing a diagnosis of pemphigus. The toxicity of leprosy blood differentiates it from "non-toxic" sera of syphilis and tuberculosis. During the past year the present authors, engaged in a study of blood sera from certain virus diseases, have made an interesting observation on these etiological agents as a class. Blood specimens were obtained from cases of experimental vaccinia, fowl pox, herpes simplex, rabies, infectious myxomatosis, Shope's fibroma, Rous's sarcoma, lymphocytic meningitis and virus III of rabbits. All these conditions yielded blood sera which were atoxic; that is, much less toxic than normal sera, a finding of as great interest as that made in connection with the phytotoxic sera mentioned above. These results are in agreement with the findings obtained some years ago in tests made on clinical cases of varicella, rubella and scarlet fever. Curiously enough, a series of blood sera from monkeys infected with poliomyelitis did not reveal this phenomenon, the resultant index being within the normal range. Previous phytopharmacological examination of one hundred trachoma bloods revealed that they possessed a specific toxicity not exhibited by sera from other pathological eye conditions which, in the light of the present study, leaves trachoma in the doubtful class. With the exception of tuberculosis and syphilis sera, which yielded slightly higher readings, blood sera from ordinary bacterial and protozoan infections gave the same phytotoxic index as normal sera.

Electrical potentials from the human brain: E. NEWTON HARVEY, ALFRED L. LOOMIS and GARRET HOBART. Extensive records of electrical potentials from the human brain have been made when the subject is awake, asleep and during hypnosis, with special attention to the regular 10-cycle rhythm called by Adrian the Berger rhythm. This appears in a person resting quietly with eyes closed or in the dark and the "mind at peace." It is abolished by the attempt to see, by emotional states and by attention. When awake, disturbances appear which interfere with the rhythm every few seconds. In sleep the disturbances which abolish the 10-cycle rhythm become more and more frequent (when drowsing) and the record changes to random potentials with an occasional short 14-cycle burst of waves, most marked from the top region of the head. The change in character from awake to sleep is not sudden, not coincident with loss of consciousness. Sounds or other disturbances during sleep even though not awakening the sleeper bring back the 10-cycle rhythm,

which appears to be connected with a change in the general level of brain activity. During hypnosis the 10-cycle frequency is slightly slower than normal but otherwise the record is no different from a normal person awake. There was no indication that this condition is similar to sleep. A pin thrust through the skin stopped the 10-cycle rhythm although there was no movement and no evidence that pain was felt. By suggestion that the subject could see or could not see, the 10-cycle rhythm could be stopped and started again. This was true whether the room was lighted or completely dark.

Growth curve of infants: C. B. DAVENPORT and WILLIAM DRAGER. Growth during the first twenty-four months postpartum, is being considered as part of the entire growth curve. This period corresponds approximately with Robertson's first monomolecular autocatalytic cycle of growth. We tried fitting various theoretical curves to the curves of growth data of this cycle. The parabola does not fit satisfactorily. Finally, we have hit upon the exponential form $y = 10^a + bx + cx^2$. This makes a fair fit for the first 18 to 20 months. Of the three terms in the exponent a represents the condition at birth; b , the acceleration factor; cx^2 , the retardation factor which makes itself strongly felt during the second year. A careful comparison of the observed and theoretical curves of growth shows with great uniformity an excess of growth above the theoretical curve at 6 months and a deficiency in growth at about 18 months. These deviations are not seasonal. If the excess growth at 6 months is seasonal then there should be an excess growth again at 18 months which is not the case. Also the babies were born at different times of the year. In rapidly growing babies the excesses and accelerations occur earlier than in slow growers. In a pair of uniovular twins the excesses and deficiencies occur at about the same time and at about the same degree. These irregularities are found not merely in weight, but also in stature, sitting height and leg length. It appears then that we have not to do with a simple autocatalytic reaction during this period; but already the curve of growth is complex. The further interpretation must rest on future study.

The absolute configurations of carbinols of the type



($n = 0$ or 1 ; $R_1 = CH_3$ or C_2H_5 ; $X = OH$):

P. A. LEVENE and ALEXANDRE ROTHEN. The configurations of a large group of substances of the above type (having $X =$ a functional group) have been correlated to that of the simplest optically active hydrocarbon and those of another large group to that of the simplest optically active secondary carbinol. It is now attempted to correlate the configurations of the two reference substances on the basis of the theories of absolute configuration.

The magnetic properties and structure of hemoglobin and related substances: LINUS PAULING and CHARLES D.

CORYELL. It is shown by magnetic measurements on blood and hemoglobin solutions that oxyhemoglobin and carbonmonoxyhemoglobin contain no unpaired electrons; the oxygen molecule, with two unpaired electrons in the free state, accordingly undergoes a profound change in electronic structure on attachment to hemoglobin. The magnetic susceptibility of hemoglobin itself (ferrohemoglobin) corresponds to an effective magnetic moment of 5.46 Bohr magnetons per heme, calculated for independent hemes. This shows the presence of four unpaired electrons per heme, and indicates that the heme-heme interaction tends to stabilize to some extent the parallel configuration of the moments of the four hemes in the molecule. The bonds from iron to surrounding atoms are ionic in hemoglobin, and covalent in oxyhemoglobin and carbonmonoxyhemoglobin.

The sexual and reproductive cycles of chimpanzee:

ROBERT M. YERKES and JAMES H. ELDER. Current knowledge of reproductive and sexual phenomena in chimpanzee is very unsatisfactory because of incompleteness and meagerness of observations. Norms based upon a statistically significant number of comparable observations are lacking. From Yale Laboratories of Primate Biology information accumulated during the past six years is presented in partial satisfaction of these deficiencies. The authors describe the 35-day sexual cycle of the chimpanzee, which typically, although not necessarily, includes menstrual bleeding, genital swelling, oestrus and ovulation; and the reproductive cycle, which includes the sexual cycle, as defined above, together with mating, fertilization, gestation, parturition and infant care. Whereas the sexual cycle of chimpanzee is approximately one week longer (35 versus 28 days) than in man, the gestational period is about one month shorter. It is indicated by the data reported that the average interval between conception and parturition is 236 days for chimpanzee, as compared with 266 days for man. Neither menstrual bleeding nor genital swelling recur regularly and typically during pregnancy; nor, under normal social conditions and for sexually mature and experienced individuals which have previously bred, does sexual intercourse occur after conception.

Altruism and cooperation among chimpanzees:

H. W. NISSEN and M. P. CRAWFORD (introduced by Robert M. Yerkes). Three main types of mutual aid among animals may be distinguished. (1) Genetically determined patterns of response, usually restricted to specific external stimuli (*e.g.*, young of the species) or particular physiological states (hormonal activity). (2) Immediate reciprocity of individual gain or concerted effort towards a common goal; barter, exchange of favors, team-work. (3) Assistance or gift to another individual without direct or apparent return to the donor; altruism. The first type is relatively common in the animal kingdom and probably finds its highest development among the insects. In chimpanzee it finds its expression in maternal care, in concerted attack on an aggressor and perhaps in grooming. Unambiguous instances of the last two types among infra-human organisms are exceedingly rare. Experiments

giving definite evidence for occurrence in chimpanzee of the second, and indicative evidence for presence of the third type, will be described. A number of problem situations, originally learned individually and then so modified that they could not be solved by one animal working alone, were mastered when two animals were given opportunity to coordinate their efforts. Cooperation did not appear at once or suddenly, and it was therefore possible to trace its development. An important feature of this development was the use of gestures, adapted to the specific demands of the situation, by one animal in stimulating the other individual to do its part of the task. When only one member of a pair had access to a limited supply of food, it shared what was available with its partner by responding to well-defined begging behavior on the part of the latter or by unsolicited giving. Previously established social relations between the individuals involved was found to be the most important of several factors determining the amount of sharing which took place. Results of these investigations will be illustrated in part by cinematic records.

The startle pattern:

WILLIAM A. HUNT and CARNEY LANDIS (introduced by R. S. Woodworth). Ultra rapid moving picture photography reveals the presence of a definite bodily behavior pattern in response to a shot stimulus. This pattern is too rapid to be seen with the eye. It includes head movement, raising and drawing in of the shoulders, abduction of the upper arms, bending of the elbows, pronation of the lower arms, clenching of the fists, contraction of the abdomen, bending forward of the trunk and bending of the knees. Its facial components include moving the head forward and down, blinking of the eyes, contraction of the risorius muscle (grin) and involvement of the sternomastoid, trapezius and platysma muscles in the neck. It differs quantitatively in various subjects, but its course is regular. It can not be voluntarily inhibited. We have studied the effects of habituation, of facilitation by other stimuli and by the injection of adrenalin, of superposing it upon other responses and of tension.

Body type and success in college:

W. B. PILLSBURY. A study of the relation between the marks of students who fall into the different body types of Kretschmer shows that the pyknic group are less successful in college work than the athletic and the asthenic. Some 980 men were divided into types by computing the Pignet Index from gymnasium measurements. It was found that there was a positive correlation ranging from 0.06 to 0.29 for different classes. The short, heavy man is not so successful as the tall slim individual. The correlation was confirmed by the fact that in the different classes, two to three times as many pyknics dropped from school and that the average standing was considerably lower. Not body form itself, but some unknown factor that affects both body form and brain is probably responsible.

The psychology of a musical ornament:

CARL E. SEASHORE. Report of progress in the psychology of the vibrato, listing the definition and identification of three

kinds of vibrato, instruments for analysis and production of all aspects of the phenomenon, a consistent terminology and graphic musical scale, statistical survey of use and abuse, the establishment of norms in voice and instruments, experimental contributions toward ideal norms of achievement, the nature of its beauty, psychophysical determination of its characteristics in hearing, explanation of some of the illusions involved, determination of the limits of tolerance and range of variability, tracing the ontogenetic and phylogenetic development, an appraisal of its contribution to the psychology of emotion and a foundation of scientific esthetics.

The effects of American environment on immigrants and their descendants: FRANZ BOAS. The general problem of the assimilation of alien populations can be solved only by a study of the modifications which bodily forms and functions undergo under new environment, and require long-continued observations on immigrants and their descendants. The data to be discussed were assembled during the past twenty-five years and certain conclusions may be presented as definitely determined. Every population investigated proved to be highly complex, including many distinct genetic lines. In every European population these are so varied that it is impossible to assign any one individual with certainty to any one population. With the transfer to American environment the bodily traits do not remain stable but undergo considerable changes. In some types the heads and faces of the descendants of immigrants are narrower than those of their ancestors. Their stature increases materially, while that of the immigrants themselves who came here in the course of fifty years does not partake of the general increase observed in Europe. The tempo of development of different races in the United States and West Indies is remarkably uniform. Contrary to opinions generally accepted no differences in the onset of puberty are found among Negroes and Whites, nor in different climates. Differences occur according to economic status. Nevertheless, each family has a characteristic tempo of development of the life span which is in part hereditary. The motor habits of East European and South European immigrants, as expressed by gestures, differ considerably. The question is in how far these are determined by heredity or by environment. A study of Italian gestures shows that these are symbolic, expressing definite ideas and have been transmitted from antiquity. Those of East European Jews are rarely symbolic, rather emotionally determined. The Italian moves symmetrically with a wide sweep from the shoulders, the Jews jerkily and

asymmetrically from the elbows, which are held close to the body. American gesticulation is much more lively than is generally assumed but is almost entirely either descriptive of forms or oratorical. In descendants of Italians and Jews who have left their national environment, a rapid transition to American posture and movement was observed. On the other hand, Englishmen were observed who had acquired Italian or Jewish gesture habits. The behavior of each individual depends also upon momentary setting in so far as it is influenced by that of the people with whom he converses. Occupational gestures were also observed. In regard to postures and gestures as expressions of motor habits complete assimilation may be predicted. Similar assimilation has been observed in regard to the general tempo of movement. Much has been said in regard to the frequency of mental diseases among immigrants and their descendants. Most of these data are based on statistical fallacies, due to the different age distribution among immigrants and natives. When these are allowed for, it appears that the differences between immigrants and natives are slight and that the second generation approaches the values found among natives; often it is less. In this investigation Irish, Italians and Germans were studied. It is noteworthy that the complete elimination of imbeciles among immigrants does not seem to have had an appreciable effect upon the frequency of imbecility among their descendants. The distribution of various types of crime differs much in different nationalities. A comparison has been made between the relative frequency of types of crime among immigrants and their descendants, and here also an approach to the relative frequencies of crimes in the native population has been determined. While individually, heredity is an important element in determining the form and functioning of the body, all these observations show that the pressure exerted by social environment brings it about that the behavior of whole populations tends to be moulded by the pattern of the dominating society.

Biographical memoir of Theobald Smith: HANS ZINSSER. (Read by title.)

Biographical memoir of Benjamin Lincoln Robinson: M. L. FERNALD. (Read by title.)

Biographical memoir of George Fillmore Swain: WILLIAM HOVGGAARD. (Read by title.)

Biographical memoir of William Duane: P. W. BRIDGMAN. (Read by title.)

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON

THE report of the Zoological Society of London for 1935, summarized in the *London Times*, states that the society has passed through one of the most successful years of its history.

1,963,136 visitors were admitted during the year, this being the highest number since 1930 and the sixth highest since the society was founded.

The assets of the society have increased by more than £14,000 and its income by nearly £19,000 over the

figures for 1934. Although the visitors to Whipsnade were nearly 45,000 fewer than in the previous year, there were over 38,000 more than in 1933.

In view of this flourishing condition expenditure on several structural additions to the Zoo has been sanctioned. Work has begun on a studio of animal art, part of the cost of which will be met by grants from the London County Council and the Middlesex County Council. A strip of Regent's Park adjoining the gardens has been granted to the society by the First Commissioner of Works, and this is to be utilized for the creation of a special children's zoo. It is hoped that both these new features will be ready during the early summer. A modernization of the middle part of the gardens, including a new elephant and rhinoceros house, is also contemplated, and it is intended that this shall be completed in 1937.

That the health of the animals has been well maintained is shown, according to the *Times*, by the fact that the death rate among mammals was the lowest recorded during the last 10 years. There has been an unusually large number of notable exhibits during the year including an okapi, presented by the King of the Belgians to the (then) Prince of Wales and given by him to the society. Other outstanding additions to the menagerie were West Indian manatees, Komodo dragons and blood-sucking vampire bats.

In scientific research the work of Dr. H. Honigman on the principles underlying the feeding of animals in the gardens and of Dr. S. Zuckerman on social behavior in apes is stated to be of great interest.

A new and more readable edition of the garden guide has been issued. Its form and illustrations are greatly improved. It includes articles by Dr. Julian Huxley, secretary of the society, on animal classification and animal adaptations.

STANDARDS FOR HYDROLOGIC DATA

AGREEMENT on common standards and specifications for hydrologic data arrived at among representatives of different government agencies and prominent hydrologists outside of government service is shown in a 45-page Report of Recommendations recently made public by Harold L. Ickes, chairman of the National Resources Committee. The report was made by a Special Advisory Committee to the Water Resources Committee of the National Resources organization, and brings into agreement the viewpoints of the producer and the user of such data.

The special committee, appointed in April of this year, consisted of Thorndike Saville, chairman, professor of hydraulic and sanitary engineering and associate dean, New York University; Donald M. Baker, consulting civil engineer, Los Angeles; H. K. Barrows, professor of civil engineering, Massachusetts Institute

of Technology; J. P. Dean, captain, Corps of Engineers, U. S. Army, New Orleans; Willis R. Gregg, chief of the U. S. Weather Bureau, Washington, D. C.; N. C. Grover, chief hydraulic engineer, U. S. Geological Survey, Washington, D. C.; W. W. Horner, consulting civil engineer, St. Louis; Joseph Jacobs, consulting civil engineer, Seattle; Royces J. Tipton, consulting civil engineer, Denver, and Robert E. Horton, of Voorheesville, N. Y., and Adolph Meyer, of Minneapolis, consulting hydrologists, who served as special consultants to the committee. The following statement is made:

The immediate urge and dominant thought governing the preparation of this report have been the provision of dependable hydrologic data by means of work relief projects. The committee has departed somewhat from the strict letter of its instructions, and has ventured to recommend certain procedures affecting the collection and publication of basic data by the regular government agencies. Inasmuch as most of such agencies were represented on the committee, the unanimity of thought as expressed in the recommendations contained in the report is highly gratifying. It is hoped that this study may have indicated a practicable procedure by which ultimate values in water resources may be effectively promoted.

The recommendations relate chiefly to the minimum standards regarded as compatible with the reliability and accuracy necessary for safe and economic design. It is insisted that more enunciation of standards is insufficient to insure satisfactory collection and publication of basic data. The fundamental premise that the technique of producing significant and dependable hydrologic data can not be imparted to inexperienced workers by means of a manual and that it can be developed only under the supervision of experienced technicians, is strongly emphasized.

The recommendations include specifications for personnel and terminology, standards for collection and compilation of data on precipitation, snow surveys, surface waters, ground water, evaporation, quality of water, suggestions with respect to special projects and recommendations for procedure surveys under the Works Progress Administration.

EXPLORATIONS SPONSORED BY THE SMITHSONIAN INSTITUTION

THE annual report of explorations of the Smithsonian Institution contains accounts of fifteen expeditions in the United States, Alaska, Canada, Greenland, South and Central America and Asia.

These expeditions resulted in many additions to the Smithsonian collections in natural history, anthropology and geology, which include fossil bones of little-known species of dinosaurs and a complete articulated skeleton of the *Coryphodon*, found in Mon-

tana and Wyoming by Dr. Charles W. Gilmore, curator of vertebrate paleontology. Dr. Charles E. Resser, curator of invertebrate paleontology, made studies of the Cambrian formation of the southern Appalachians. Fossils were gathered from Devonian rocks in the Midwest by Dr. G. Arthur Cooper, paleontologist of the National Museum.

Minerals and meteorites were collected for the institution and for Harvard University by Mark C. Bandy during a four-month field expedition in Chile. His work included a visit to the sulphur mine on the summit of Mount Auncanquilecha, more than 20,000 feet above sea-level, in search of sulphur crystals.

Gerrit S. Miller, Jr., curator of mammals, made a study of the mammals peculiar to the Florida Keys, extending from Miami to Key West. Dr. Doris M. Cochran, assistant curator of reptiles and batrachians, reports on a frog-collecting expedition in Brazil, during which she obtained specimens for the U. S. National Museum. Dr. Waldo L. Schmitt, curator of marine invertebrates, visited the Peruvian "bird islands" and the Galapagos. He was a member of the Hancock expedition of the winter of 1934-35.

Captain Robert A. Bartlett, Arctic explorer, describes the results of an expedition made last summer under the joint auspices of the Smithsonian Institution and the Field Museum of Natural History of Chicago. On this expedition he renewed acquaintances among the Eskimos living in a native village on the south side of Cape York Bay, who took part in the Peary expedition. Collections of Arctic plankton were made for the Smithsonian collections.

The Reverend David C. Graham continued his explorations in the province of Szechwan, China. In the face of troubled political conditions he found it possible to make collections on the slopes and summit of Mount Omei, one of the sacred mountains of China.

Dr. Aleš Hrdlička conducted excavations for the fourth summer on Kodiak Island, Alaska. Neil M. Judd, curator of archeology, visited San Juan Teotihuacan in Mexico, the Toltec religious center, and its massive pyramids. He also visited other Aztec and Toltec religious centers in Mexico, including Monte Alban. Herbert W. Krieger, curator of ethnology, visited the Potomac shores of Maryland and Virginia locating the old village sites of the Powhatan Confederacy and the settlements of the surviving Indians. Matthew W. Stirling, chief of the Bureau of American Ethnology, conducted an anthropological reconnaissance in Guatemala, Honduras and Yucatan. Dr. Frank H. H. Roberts, Jr., of the bureau, continued his excavations in northern Colorado at the earliest known inhabited site in North America. Basic Indian language studies were conducted by Dr. Truman

Michelson among the Indians and Eskimos who inhabit the desolate shores of James and Hudson's Bays.

THE ATLANTIC CITY MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

THE annual meeting of the American Society for Testing Materials will be held in Atlantic City at Chalfonte-Haddon Hall, from June 29 to July 3, inclusive. In order to provide ample time for the presentation of the papers and for discussion, some twenty sessions are being arranged.

There will be several symposia, the most extensive of which is on "X-ray Crystallography and Radiography," which are being arranged by the committee on metallography through its subcommittee on x-ray methods. The symposium on "Limitations of Laboratory and Service Tests in Evaluating Rubber Products," sponsored by the committee on rubber products, is expected to be of unusual interest. Several papers dealing with various phases of spectrographic analysis are on the program and one session will be devoted entirely to the subject of water, which is being sponsored by the joint research committee on boiler feed-water studies and the committee on water for industrial uses. Other technical contributions will cover non-ferrous metals, wire, soils, corrosion, fatigue and effect of temperature on metals, and cement and concrete, separate sessions being devoted to each of these subjects.

Monday, June 29, is being reserved for meetings of committees, and the first session is scheduled for Tuesday morning, when there will be an address on "Chemical Engineering and its Relationship to the Work of the American Society for Testing Materials," by H. C. Parmelee, McGraw-Hill Book Company, and the president's annual address, to be given by H. S. Vassar.

The 1936 Edgar Marburg lecture, the tenth in the series, is to be presented on Wednesday afternoon by Dr. Arthur L. Day, director of the Geophysical Laboratory, Carnegie Institution of Washington, on "Developing American Glass," in which work Dr. Day has taken a leading part.

The symposium on "X-ray Crystallography and Radiography," which is being directed by Dr. R. F. Mehl, director, Metals Research Laboratory, and head, department of metallurgy, Carnegie Institute of Technology, will comprise twelve papers, six on radiography and six on diffraction. Preliminary sessions were held at the 1935 meeting in Detroit, at which many technologists in this field presented material which is to be the basis of the formal symposium. The primary objects of the symposium are stated as follows: (a) To describe modern methods and equipment in an elementary way in order to assist industries in the ap-

application of x-rays to their work. (b) To present as many case histories of successful applications as possible. (c) To compare the usefulness of x-ray methods with the usefulness of other methods which may be used alternatively. (d) To include the application of radiographic and diffraction methods to both metallics and non-metallics.

In the section for radiography the papers will cover such subjects as elements of radiography, foundry applications, applications to the welding art, gamma-ray radiography and its relation to x-ray radiography and the problems of specifications. The diffraction section comprises papers on equipment and methods, constitution of alloys, chemical analysis and particle-size determinations, non-metallic applications, and cold-work, recrystallization and preferred orientations. It is expected that four sessions of the meeting will be devoted to this symposium, which it is expected will be the most extensive of any that have been sponsored by the society.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

At the annual meeting of the American Academy of Arts and Sciences, held on May 13, at its house, 28 Newbury Street, Boston, thirty-four new fellows and six foreign honorary members were elected. The fellows in the exact and natural sciences are:

Mathematical and Physical Sciences

Harold S. Booth, Western Reserve University.
Albert B. Hastings, Harvard University.
Murray P. Horwood, Massachusetts Institute of Technology.
Ernest H. Huntress, Massachusetts Institute of Technology.
Avery A. Morton, Massachusetts Institute of Technology.

Natural and Physiological Sciences

Oswald T. Avery, Rockefeller Institute.
Charles S. Burwell, Harvard University.
Frederick L. Hisaw, Harvard University.

The following officers were elected for the ensuing year:

President	Roscoe Pound
Vice-president for Class I	James Flack Norris
Vice-president for Class II	Walter Bradford Cannon
Vice-president for Class III	Edwin Francis Gay
Vice-president for Class IV	Arthur Stanley Pease
Corresponding Secretary	Tenney Lombard Davis
Recording Secretary	Walter Eugene Clark
Treasurer	Ingersoll Bowditch
Librarian	Hervey Woodburn Shimer
Editor	William Chase Greene

The meeting was addressed by Professor Julius

Seelye Bixler, of Harvard University, who spoke on "The Skeptical Revolt."

THE SEATTLE MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ARRANGEMENTS for the twentieth meeting of the Pacific Division of the American Association for the Advancement of Science, to be held at Seattle from June 16 to 20, are now complete. The final program, which is in press, announces the meetings of twenty-four affiliated and associated societies and the titles of some three hundred and eighty papers. The sessions of general interest to members and guests which have been organized under divisional auspices comprise a symposium on oceanography and reports on the progress of research in four selected fields. The symposium on oceanography will consist of four addresses as follows: Marine Biology, C. McLean Fraser; Chemical Oceanography, Erik G. Moberg; Fisheries, W. F. Thompson; Hydrographic Survey, O. W. Swainson. The session devoted to surveys of current research will focus attention upon a few of the most noteworthy achievements and will outline the problems of commanding interest. The subjects and speakers follow: Stellar Spectroscopy, W. E. Harper; Plant Nutrition, D. R. Hoagland; Chemistry of Growth Principles, Roger J. Williams; Paleontology, E. L. Packard. Addresses of general interest will be given on the evenings of Tuesday, Wednesday and Thursday. At the first of these, Dr. F. K. Kirsten, professor of aeronautical engineering at the University of Washington, will speak on "Lux Sit," an exposition of researches in the field of illumination with rare gases and metallic vapors under electrical stimulation. On Wednesday evening, Dr. Richard C. Tolman, professor of physical chemistry and mathematical physics at the California Institute of Technology and president of the Pacific Division, will deliver an address on "The Present Status of Cosmology." The Thursday evening address will be delivered by Dr. F. C. Mann, professor of experimental surgery in the University of Minnesota and director of the Institute of Experimental Medicine of the Mayo Foundation. The subject of Dr. Mann's address will be "Methods of Medical Progress."

The chairman of the local committee in charge of arrangements is Professor A. F. Carpenter, of the department of mathematics, University of Washington, to whom any inquiries regarding local facilities may be addressed.

All members of the American Association for the Advancement of Science resident in the territory of the Pacific Division will receive a copy of the program by mail in advance of the meeting.

SCIENTIFIC NOTES AND NEWS

FELLOWS of the Royal Society, London, have been elected as follows: A. C. Aitken, lecturer in mathematical statistics and actuarial mathematics, University of Edinburgh; J. D. Cockcroft, demonstrator in physics, University of Cambridge; H. J. Fleure, professor of geography and anthropology, University of Manchester; C. Forster-Cooper, director of the University Museum of Zoology and reader in zoology, University of Cambridge; Sir Alexander Gibb, consulting engineer; H. L. Guy, chief engineer, mechanical engineering department, Metropolitan Vickers, Ltd.; H. G. A. Hickling, professor of geology, Armstrong College, Newcastle-on-Tyne; Lancelot Hogben, professor of social biology, University of London; J. Kenyon, head of the chemistry department, Battersea Polytechnic; E. H. Kettle, professor of pathology, University of London; N. F. Mott, professor of theoretical physics, University of Bristol; R. G. W. Norrish, lecturer in physical chemistry, University of Cambridge; H. H. Plaskett, Savilian professor of astronomy, University of Oxford; E. F. Relf, superintendent, aerodynamics department, National Physical Laboratory; F. J. W. Roughton, lecturer in physiology, University of Cambridge; Birbal Sahni, professor of botany, University of Lucknow, and E. B. Verney, Shields reader in pharmacology, University of Cambridge.

THE Faraday Medal of the Institution of Electrical Engineers has been presented to Sir William Bragg. The presentation preceded the twenty-seventh Kelvin Lecture, which was delivered by Dr. J. D. Cockcroft, who spoke on "The Transmutations of Matter by High-energy Particles and Radiations."

THE British gold medal for aeronautics has been awarded by the Amulree Committee, on the recommendation of the council of the Royal Aeronautical Society, to Dr. Hugo Eckener for his technical achievements in lighter-than-air craft. The silver medal has been awarded to A. J. Rowledge, for his scientific achievements in the development of aircraft engines.

FOR "outstanding success in the direction of aeronautical research and for the development of original equipment and methods," George William Lewis, director of aeronautical research of the National Advisory Committee for Aeronautics, Washington, D. C., has been awarded the Daniel Guggenheim Medal for 1936. Mr. Lewis designed the first experimental Roots type supercharger for aircraft engines based on the design of the Roots type blower. The medal was established in 1927 by the Daniel Guggenheim Fund for the Promotion of Aeronautics. Mr. Lewis is the eighth medallist. Other recipients have been Orville

Wright, Ludwig Prandtl, Frederick William Lancaster, Juan de la Cierva, Jerome Clarke Hunsaker, William Edward Boeing and William Frederick Durand.

THE Institute of Radio Engineers has awarded the Morris Liebmann memorial prize for 1936 to B. J. Thompson, in charge of the electrical research section of the RCA tube laboratory at Harrison, N. J. The award was made for Mr. Thompson's "contribution to the vacuum tube art in the field of very high frequencies." The prize is awarded every year to the radio worker who, in the opinion of the award committee, "has made the most outstanding contribution to the advancement of radio technique in the near past." The annual prize consists of the income from a fund set aside by an anonymous donor in memory of Colonel Morris Liebmann, a member of the institute, who was killed in the war.

THE gold medal of the Explorers' Club, New York City, was presented to Lincoln Ellsworth on May 12, his fifty-sixth birthday. The presentation was made by Mr. Herbert Hoover. Dr. Isaiah Bowman, president of the Johns Hopkins University, formerly director of the American Geographical Society, New York City, in introducing Mr. Hoover, described the medal, which was inscribed with Mr. Ellsworth's name, and the notation—"Courageous explorer upon Arctic and Antarctic horizons." Other speakers were Vilhjalmur Stefansson, Arctic explorer, and Dr. Raymond Priestley, vice-chancellor of the University of Melbourne, a member of the Shackleton and Scott expeditions to the Antarctic. Sir Gerald Campbell, consul general in New York, brought the greetings and congratulations of Great Britain.

THE Cornell Society of Engineers gave a testimonial dinner in New York City on May 21 to Dr. Dexter S. Kimball, who retires this year as dean of the College of Engineering of Cornell University.

A BANQUET by the Alpha Chi Sigma chemical fraternity was tendered on May 9 to Professor Hal W. Moseley, head of the department of chemistry at Tulane University, in honor of his twenty-fifth anniversary as a member of the faculty. A. W. Chapman, counselor for the tristate district, presented to Professor Moseley his portrait in oils by N. M. Comte.

DR. HERBERT S. GASSER, director of the Rockefeller Institute for Medical Research, New York, has been elected a corresponding member of the Argentine Biological Society of Buenos Aires.

THE honorary degree of doctor of science will be conferred by the Montana State College at the com-

mencement exercises on June 9 on Professor Robert Allen Cooley, formerly head of the department of entomology.

THE University of Manchester conferred on the occasion of Founder's Day on May 20 the degree of doctor of science on Dr. Max von Laue, professor of theoretical physics in the University of Berlin, and on Dr. J. B. Leathes, emeritus professor of physiology in the University of Sheffield.

DR. J. TATE MASON, president-elect of the American Medical Association, who is dangerously ill in a Seattle hospital, was inaugurated *in absentia* as president at the Kansas City meeting. Dr. John H. J. Upham, dean of the College of Medicine of the Ohio State University, was made president-elect to take up office next year.

DR. THOMAS R. BOGGS, chief visiting physician at the Baltimore City Hospitals and a member of the faculty of the Johns Hopkins Medical School, was elected on May 6 president of the Association of American Physicians to succeed Dr. Rollin T. Woodruff, professor of medicine at the Rush Medical College, University of Chicago.

AT the recent meeting of the American Society of Biological Chemists, in Washington, D. C., the following officers were elected: *President*, H. B. Lewis, University of Michigan Medical School; *Vice-president*, G. E. Cullen, Children's Hospital, Pediatric Research Foundation, Cincinnati; *Secretary*, H. A. Mattill, State University of Iowa; *Treasurer*, A. B. Hastings, Harvard Medical School; *Additional Members of the Council*, J. B. Collip, McGill University; E. A. Doisy, St. Louis University School of Medicine, and W. C. Rose, University of Illinois. The next meeting will be held at Memphis, Tenn., from April 21 to 24, 1937.

OFFICERS elected at the sixth annual meeting of the American Malacological Union, which was held in St. Petersburg, Fla., from April 21 to 24, are: *President*, Joshua L. Bailly, Jr., Baltimore; *Vice-president*, Dr. Carlos de la Torre, University of Havana, Cuba; *Corresponding Secretary*, Norman W. Lermond, Knox Academy of Arts and Sciences, Thomaston, Me.; *Financial Secretary*, Mrs. Imogene C. Robinson, Buffalo Museum of Science; *Honorary Presidents*, Mrs. Ida S. Oldroyd, Stanford University, Calif., Dr. Henry A. Pilsbry, Philadelphia Academy of Natural Sciences. Other members of the Council are: Dr. Paul Bartsch, Smithsonian Institution; William J. Clench, Museum of Comparative Zoology, Cambridge; Calvin Goodrich, University of Michigan, and Professor Junius Henderson, University of Colorado. The meeting next year will be held at the University of Michigan.

DR. HERBERT E. WINLOCK, director of the Metro-

politan Museum of Art, was elected on May 11 president of the American Association of Museums. Dr. Hermon Carey Bumpus and Arthur C. Parker, director of the Rochester Museum of Arts and Sciences, were elected vice-presidents. New directors elected were Kenneth Chorley, president of Colonial Williamsburg, Inc.; O. T. Kreusser, director of the Museum of Science and Industry, Chicago, and Mrs. John D. Rockefeller, Jr., trustee of the Museum of Modern Art.

DR. MAXIMILIAN TOCH has been elected president for two years of the American Institute of Chemists; Robert J. Moore, of the Bakelite Corporation, has been elected vice-president.

THE Louisiana Academy of Science held its ninth annual meeting at Southwestern Louisiana Institute, Lafayette, La., on March 27 and 28, under the presidency of Dr. Ellinor H. Behre, professor of zoology at the Louisiana State University. The meeting was divided into five sections—applied science, physical science, geology and geography, biological science and social science. The annual research grant from the American Association for the Advancement of Science was awarded to H. C. Eshelman, of Southwestern Louisiana Institute. Dr. R. C. L. Mooney, of Newcomb College, New Orleans, received the award for the best paper presented. Harold Frediani, of Louisiana State University, won the graduate award, and Francis LeBeau, of Southwestern Louisiana Institute, won the undergraduate award.

THE University of Minnesota has conferred the title of professor emeritus on Dr. Charles Mayo, professor of surgery of the Mayo Clinic at Rochester, Minn. Dr. Mayo has resigned after having served as professor of surgery without salary since 1919.

DR. RICHARD SWANN LULL, for the past thirty years a member of the Yale University faculty, will retire next month from active teaching. Dr. Lull, who is Sterling professor of paleontology, will continue as acting director of the Peabody Museum of Natural History, a post that he has held since 1922. He is also the editor of *The American Journal of Science*.

DR. WILLIAM S. LADD, associate and acting dean of Cornell University Medical College, has been appointed dean; he has also been named professor of medicine. Dr. Ladd graduated from Columbia University College of Physicians and Surgeons in 1915. He resigned from the Columbia faculty in 1931 to become assistant professor of clinical medicine and associate dean at Cornell.

DR. GEORGE B. PEGRAM, professor of physics at Columbia University, formerly dean of the School of Mines, Engineering and Chemistry, has been named

acting dean of the Graduate Faculties, replacing Dr. Howard Lee McBain, who died recently.

DR. WARREN H. COLE, assistant professor of clinical surgery, Washington University School of Medicine, St. Louis, has been named professor and head of the department of surgery at the University of Illinois College of Medicine, Chicago, to succeed the late Dr. Carl Hedblom.

PROFESSOR A. O. RHOAD, formerly of the Instituto de Pesquisas Agronomicas of Pernambuco, Brazil, has accepted a position in the U. S. Department of Agriculture as superintendent of the Iberia Livestock Experiment Farm in Louisiana.

DR. THEODORE G. KLUMPP, assistant clinical professor of medicine in the Department of Internal Medicine of Yale University, will be granted leave of absence for the academic year 1936-1937 to go to Washington, where he will make a study of glandular and anti-anemic preparations with the Food and Drug Administration of the U. S. Department of Agriculture.

DR. CLAY HUFF, associate professor of bacteriology at the University of Chicago, will work at the Bass Biological Laboratory for three or four months continuing his work on avian malaria. He is also carrying on a preliminary survey of the parasites appearing in the blood stream of Crustaceans and their effect on cell forms.

DR. E. V. MCCOLLUM will sail for Geneva on May 23. As the United States representative on the Mixed Committee on Nutrition of the Health Section of the League of Nations he will attend the meeting of this commission from June 1 to 12. He will then join the Health Commission of the League of Nations as a guest of the USSR and will spend a month in Russia. The itinerary includes Leningrad, Moscow, the Caucasus Mountain region, the Crimea and the Ukraine. He will return to the United States early in August.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, gave an address entitled "Groping in the Darkness" before the annual meeting in New York City of Phi Beta Kappa on May 21.

DR. OSCAR RIDDLE, of the Department of Genetics of the Carnegie Institution of Washington, Cold Spring Harbor, N. Y., addressed the New York University chapter of Sigma Xi, on May 8, on "Major Functions of Our Anterior Pituitary Glands."

DR. ALESSANDRO GHIGI, professor of zoology and rector of the University of Bologna, will be the speaker at the sixty-third annual commencement of Boston University on June 15.

THE Michigan Chapter of the Society of the Sigma

Xi held its annual initiation banquet on May 6. Eight faculty members and twenty-five graduate students were elected to full membership, and sixty-eight students were elected as associates. In addition three associates were advanced to alumni membership and thirty-three associates to full membership. Dr. E. C. MacDowell, of the Carnegie Institution, Cold Spring Harbor, N. Y., delivered the address of the evening on "Wild Blood Cells."

AT the annual dinner of the Princeton Society of Sigma Xi, on May 12, forty persons were elected to associate membership and twenty-six, including eighteen former associate members who are now graduate students, were elected to full membership in the society. Dr. Carl TenBroeck, director of the department of animal and plant pathology of the Rockefeller Institute, was elected president of the chapter. Dr. Nathaniel H. Furman, associate professor in the department of chemistry of Princeton University, was elected vice-president. Professor Louis A. Turner, of the department of physics, and Professor Erling Dorf, of the department of geology, will continue for another year as secretary and treasurer.

THE western summer meeting of the Botanical Society of America convenes at the University of Wyoming Camp on July 27, immediately after the close of the Camp School. Further information and reservations may be secured from Dr. Aven Nelson, chairman of the local committee, Laramie, Wyo.

THE thirty-eighth annual meeting of the Medical Library Association will be held in St. Paul, Minn., on June 22 and 23, and in Rochester, Minn., on June 24. The program will include addresses, discussions and demonstrations on library procedure, medical history and literature. This association consists of about 175 of the medical libraries of this country and Canada, together with their librarians and a group of supporting members who are physicians interested in the advancement of medical libraries. The officers are: *President*, Dr. W. W. Francis, Montreal; *Vice-president*, Dr. A. H. Sanford, Rochester, Minn.; *Secretary*, Miss Janet Doe, New York; *Treasurer*, Miss Mary Louise Marshall, New Orleans, and *Chairman of the Executive Committee*, Miss Marjorie J. Darrach, Detroit. All interested in the development of medical libraries and a wider knowledge of medical literature are invited to attend.

AT the recent meeting of the National Academy of Sciences the following grants were made from the Alexander Dallas Bache Fund: To Dr. Eric Ponder, for the study of the effect of narcotics on the electrical changes in heart muscle; to Dr. Malcolm Dole, for the comparative study of the atomic weight of oxygen in air and in the carbonate rocks; to Demorest Daven-

port, for taxonomic and genetic studies of the genus *Coenonympha* (Lepidoptera), and to Robert R. McMath, for a precision Bell and Howard gate mechanism for recording the phenomena of solar prominences. With the resignation of Dr. Heber D. Curtis, the board of directors of the Bache Fund is now: Dr. Edwin B. Wilson, *chairman*, Dr. W. J. V. Osterhout and Dr. C. R. Stockard.

THE George L. and Emily McMichael Harrison department of research has been established at the Uni-

versity of Pennsylvania. This was made possible under the terms of the will of the late George Leib Harrison, a retired chemical manufacturer, cousin of the late Provost Charles Custis Harrison, by which the university receives the income from the residuary estate, approximating \$40,000 annually. The George L. and Emily McMichael Harrison professorship in surgery has been formally established and the new chair has been filled by the appointment of Dr. Isidor S. Ravdin, J. William White professor of surgical research in the School of Medicine.

DISCUSSION

BUREAUCRACY AS A WAY OF LIFE

THE government worker lives in a glass house—his hours, his pay, his tasks are known or may be known to all. As a dweller in a glass house he is by proverb prohibited from throwing stones. On the other hand, he has been for years the target for two general, almost blanket, criticisms—first, that he is an inefficient workman and, second, that he is a moral weakling.

Recently less has been said about the inefficiency of government workers. This may well be because of the drastic deflation undergone in the standing of our leaders of industry, trade and banking. On the other hand, certain by no means to be despised voices have been raised to the effect that the government worker is at least as efficient as, perhaps more efficient than his brother in industry. Witness for example the statement of Oswald Garrison Villard:¹

I have not been moved to call attention to Mr. Eastman because he is exceptional; there are many other public officers who are serving the government with great ability and devotion. He himself answers the question whether it is possible for a government to enlist men of first-class competence and shining integrity without paying them the high salaries offered by private corporations to the men they select for president or vice-president. When I contrast the character and talents of Mr. Eastman with those of some of the men who have been paid a million dollars a year by banks and steel companies, it is to laugh. . . . I have no doubt that he could have wangled a fat job for himself from some of the large corporations years ago, and feathered his own nest most richly. He has preferred his small Government salary and the privilege of serving his fellow-countrymen, which is delightful proof that the private-profit motive is not essential to the carrying on of a civilized government. And there are many like Mr. Eastman.

In the same vein we have the thoughtful statements of Charles and William Beard in "The Case for Bureaucracy":²

It would be easy to pick out illustrations of steady and efficient functioning on the part of numerous bureaus and agencies in Washington—work done by the bureau of mines in saving human lives, by the coast guard in stormy seas winter and summer, by the men who manage the vast system of airways, by the forest service in conserving and guarding the national forest domain, by the public health service, and so on through a catalogue filling a volume. Where we find a bureau functioning in some field that does not invite collision with private enterprise, we usually discover the most intelligence and public spirit. But generally the bureaus are hampered in constructive work by acquisitive pressures from the outside. . . .

With more direct reference to the scientific work of the government, R. L. Duffus, writing in *Harper's* for June, 1933, says:

Consider the scientific agencies which can be found in almost all the departments. They are full of men who are building roads into the future. In stuffy little offices, in laboratories smelling of chemicals and of decaying organic matter, these devotees study the habits of insects, the diseases of poultry, human beings, and livestock; they test soils and seeds, they weigh the earth and the stars, and when called upon as Paul de Kruif has glowingly related, lay down their lives in a rather casual way for the service of mankind.

A somewhat special class, perhaps, these investigators, but for the larger groups also there are to be found defenders. For example, the Beards point out that the efficiency of the fire departments of our various cities (manned chiefly by Civil Service employees) is recognized not only by occasional notice of a particular heroism in newspapers, but strange as it may seem by that all-important American document, the balance sheet. Fire-insurance companies make it a practice to lower their rates in cities which have standard equipment for fighting fires. The assumption is that if the men have the apparatus, they will use it effectively. Here business takes the efficiency of government for granted and measures results in dollars and cents.

¹ *Nation*, February 7, 1934.

² *Scribner's Magazine*, 93: 4, April, 1933.

Secretary of Agriculture H. A. Wallace, in speaking a year or two ago before a group of Department employees, paid obviously sincere tribute to the fidelity and ability of government workers and the efficiency with which government work is conducted. Referring specifically to the clerical force, he said that he well remembered and had come to agree with the point of view of his father, Secretary of Agriculture in the Harding Administration, who said at that time that he found that federal clerical work was more efficiently conducted than similar work in private business and planned to take some of the federal workers back with him when he retired to private life.

So much for efficiency; now as to morality. Only last week our minister insisted from the pulpit, with cautious reservations in favor of those with intellectual interests, that working for the United States Government is bad for the character. From listening to his sermons on a surprising number of Sundays, I take it that he feels that the particular type of competitive effort supposed to be associated with business and with most of the professions is necessary to the development of real character.

This idea is not new even to the clergy. I have recently read a letter dated October 11, 1850, from the Reverend A. P. Chute, then of Lynnfield, Massachusetts, to a brother clergyman in Maine, which includes the following paragraph:

I observe that your bro. Maurice has lost his office at Belfast. My brother who was a subordinate in the Castine office will also lose his office probably, though it is not certain. He is, however, expecting it. It should not be regretted either by them or their friends for office-holding under the Government has a bad effect on men, intellectually & morally. A man long in public office loses his spirit of *self-reliance* if he does not deteriorate in moral character.

(To point out that this same A. P. Chute writes in September, 1861, "At his desk in the Custom House Boston" to his "Dear Brother Blake" would not add anything to the present discussion.)

The agreement of these reverend gentlemen, separated in time by an eighty-year interval, is impressive. Whether they are correct depends on one's ideas of "character" and "morality." This problem is well stated by the Beards in the article to which reference has already been made.

Is the bureaucrat's morality, the job holder's morality, ipso facto, worse than the business man's morality? Who are our leading business men? They are the men who have made the most money. What is the rule of business? It is to buy in the cheapest market and sell in the dearest, to give as little as possible for as much as one can get. If a dreamy professor comes along, meets a realtor, and

pays him a thousand dollars more for a house than the latter is willing to sell it for, would not the former be condemned as a fool in any well-bred American community and the latter congratulated on "making a good thing out of the deal?" There are exceptions, to be sure, and much talk about service, but the business of business is to get money, to collect what the traffic will bear. If not, what is it?

The justification for this kind of ethics is that it supplies initiative, but peril of it lies in the fact that no civilization can endure which has written over its shrine: No profit, nothing doing. And the justification of the bureaucracy lies in the fact that, allowing for dead wood and dead heads, it supplies from top to bottom an ideal which this country needs, the true soldier's ideal, namely, that great deeds may be done without hope of profit, either near or distant, openly and professed or sneakily and concealed.

The real problem then seems to boil down to something like this. Is active labor under a profit system necessary to the development of character? Curiously enough, at least one great organization stands fast in the faith that an entire absence of such a motive is necessary to the highest development of character. Our largest church by formal vows makes sure that its leaders shall be free from the distractions of profit seeking and most of our smaller denominations wisely make equally certain by somewhat less formal means of a similar position in their clergy.

The great educational institutions also while carrying on a rather mild competition among themselves on salary schedules have never attempted to compete with business concerns. Curiously, or perhaps naturally, enough, the college professor like the clergyman sometimes sighs for the degeneracy of his brother in the Civil Service of the United States.

In a biographical sketch of the late Roland Thaxter of Harvard, his successor recounts a discussion of possible openings in which Dr. Thaxter remarked with a sigh, "Of course one can always get some sort of position in Washington, and even able men like Dr. Lyman seem to like it there, I'm sure I don't know why!" Now the answer is simple. Even able men "like it" in the Civil Service because it enables them to do effective and useful work among pleasant people who are companionable and understanding.

Dr. George Sarton, who is spending his life in the study of science in relation to human life in the past as well as in the present, points out the relation of surroundings to the deepest happiness in the following phrase:

To be truly happy and gay we must be able to pursue the truth, not alone, but among lovable men and women, who are kind to us and to whom we can show our own kindness. Even as the discovery of any particle of truth, whether it be to our advantage or not, pleasant or un-

pleasant, is a positive gain for the whole world, even so every act of kindness is a creation in the right direction.

Our tactful family physician says that our village is a pleasant place in which to live because it contains a large per cent. of men who have been very careful in the selection of their wives. Without attempting to defend this somewhat startling generalization I will adopt his phraseology and assert on the basis of over twenty years of work in its ranks that the Civil Service is a pleasant place to live and work because it is made up of carefully selected people. Selected not so much by the formal tests as by the type of work they do, the type of life they may be expected to lead, and the almost entire absence of a profit motive. I believe them to be distinguished among American groups for courtesy, generosity, industry, honesty and happiness. Whether the characteristics which I find among my associates are to be rated as good or bad I must leave to the clergymen to decide. That is their field of specialization—not mine. But I have the feeling that they bear strong resemblance to the ideas held out as ideals by certain great moral leaders of different ages.

NEIL E. STEVENS

BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

A REPRODUCTION PHENOMENON

IN certain species of parasitic Hymenoptera, particularly those belonging to the genus *Coccophagus*, the males develop only as parasites of hymenopterous larvae and the females only as parasites of homopterous nymphs or adults; i.e., mealybugs or scale insects. The hymenopterous host, however, must be within a homopterous insect. This is a remarkable differentiation in the host relations of the sexes within a species.

The production of males in a pure culture of a species having such a habit necessitates the destruction of immature females since they are the only hosts of the male present in the culture. The conditions under which the destruction of the females occurs vary with the species.

Apparently in all the species the female is endoparasitic. The male, however, in some species, may be endoparasitic, in some ectoparasitic and in others alternately ectoparasitic and endoparasitic. The male exhibits marked differences in the structure of the respiratory system and other morphological characteristics.

As in other species of Hymenoptera, the male develops from unfertilized eggs deposited by unmated females. These females either deposit their eggs directly on or in the immature hymenopterous host or they deposit them in the fluid media surrounding such hosts. In this fluid media the eggs remain un-

hatched until the hymenopterous host is in a suitable condition for attack.

This peculiar phenomenon is of practical importance in the biological control of insect pests.

S. E. FLANDERS

CITRUS EXPERIMENT STATION
RIVERSIDE, CALIF.

PSEUDOLARIX AMABILIS, A NEW HOST FOR DASYSYPHA WILLKOMMII¹

DURING recent months the writers scouted for *Dasyscypha willkommii* (Hartig) Rehm, the European larch canker organism, in radii of 2½ miles from the present known centers of infection in the two towns of Hamilton and Ipswich, Massachusetts. Though paying strict attention to the species of *Larix* present, several cankers closely resembling those caused by the disease on imported *Larix europaea* were observed on the branches of a golden larch, *Pseudolarix amabilis* Rehder. Specimens of the host were sent to and identified by Alfred Rehder at the Arnold Arboretum, while G. G. Hahn at the Federal Laboratory of Forest Pathology in New Haven, Connecticut, identified *Dasyscypha willkommii* from cultures typical of the parasite made from the inner bark of that host. This is the first host genus other than *Larix* upon which the true European larch canker organism has been reported in America.

J. ARMSTRONG MILLER
KENNETH F. ALDRICH

IN AID OF DR. LUDWIG MACH

DR. LUDWIG MACH, the only surviving son of the late Ernst Mach, is threatened by economic pressure with the prospect of having to abandon the house and laboratories in which he has for years endeavored to complete his father's physical researches. The premises contain a complete Archiv with Ernst Mach's notebooks and diaries, on the basis of which Dr. Ludwig Mach had hoped to prepare a memoir of his father's life. Eviction from the valuable but heavily mortgaged property would mean the destruction of all the material assembled. 3,000 to 4,000 marks would enable Dr. Mach to complete Volume II of the *Prinzipien der physikalischen Optik*, while 500 to 600 marks would stave off the immediate difficulty. Since the case is urgent, remittances of those interested should be addressed directly to Dr. Ludwig Mach, Vaterstetten bei München, Wasserburger Landstrasse 61, Germany.

ROBERT H. LOWIE

¹ Report from Emergency Conservation Work and Division of Forest Pathology, Bureau of Plant Industry, in cooperation with the Northeastern Forest Experiment Station and Osborn Botanical Laboratory, Yale University.

SOCIETIES AND MEETINGS

FORMATION OF AN ACADEMY OF MEDICINE IN WASHINGTON, D. C.

ON April 28, 1936, the Academy of Medicine of Washington, D. C., was organized and had its initial meeting. Officers elected were: *President*, Dr. William A. White; *vice-president*, Dr. Carl Voegtlin; *treasurer*, Dr. William C. White; *secretary*, Dr. Errett C. Albritton; *directors*, Drs. Aleš Hrdlička, Sterling Ruffin, Lyman J. Briggs, Earl B. McKinley and Matthew W. Perry. The academy membership is limited to 60 ordinary resident members and 30 associate and non-resident members.

As stated in its constitution, the academy has been organized "for the advancement of the science of medicine and to promote the mutual exchange of knowledge between medical and other scientific groups."

In the formation of medical groups two opposite trends may be noticed, the main one toward a greater differentiation of function, the other toward a reunification of interests. The first is a reflection of the process of cleavage and development, still going on, by which an amazing number of sciences has been derived from the originally undifferentiated profession of the healing of the sick; the other represents an effort to overcome the disadvantage of divergence that accompanies differentiation.

Two large groups in particular have been carried apart in this process, the clinicians and clinical investigators, and the laboratory investigators in medicine. Two others may be named that have little professional contact with these, workers in public health and men in the sciences allied to medicine. In each of these groups professional societies or sections of societies have grown up with ever more precisely limited objectives. Work is so active at every frontier that only an occasional guest speaker from one field can bring word to those in another that permits direct interchange of ideas between them.

The organization of the Academy of Medicine of Washington is one of the infrequent instances of a movement counter to this general trend. It draws its membership from all medical and associated scientific groups, and will serve as a forum for exchange of ideas and discussion of problems of general interest in medical science.

To one who is aware of the remarkable diversity of medical and related fields represented in Washington, an organization of this sort would seem long overdue. In addition to the various clinical fields, those of pharmacology, nutrition, chemistry, medical zoology, immunity and others are represented in the staffs of the National Institute of Health and the Beltsville Research Center; anthropology is represented in the

staff of the National Museum; research in physics and physical chemistry is in progress at the Bureau of Standards; laboratories of the various preclinical medical sciences are found in the medical schools of the city, and in other organizations such fields are represented as army and navy medical administration, public health administration, epidemiology, parasitology, experimental medicine, national medical library administration, medical sociology, entomology, mycology and others.

The situation in Washington is uniquely favorable for the development of a forum in which problems of general interest in medical science may be examined from all angles. In the presence of an opportunity so unusual it is believed that the academy has acted wisely in giving no special emphasis to the medical degree as compared with the doctor's degree in one of the medical or allied sciences, and that in this sense its membership is non-medical as well as medical.

E. C. A.

THE NEW ORLEANS ACADEMY OF SCIENCES

THE New Orleans Academy of Sciences held its eighty-third annual meeting on March 20 and 21, at Tulane University, New Orleans, with a formal registration of 226 and a gross attendance, at all sessions, lectures and demonstrations, of approximately 700. Thirty-eight papers were presented at the technical sessions on Friday afternoon, distributed as follows: Sections A and E (Physics, Engineering, Mathematics, Astronomy, and Geology), 8; Section B (Chemistry), 7; Section C (Biological Sciences), 9; Section D (Medical Sciences), 8; Section F (Social Sciences), 6.

The annual public address, delivered this year by Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, on "Some Studies Regarding Popular Notions and Modern Science," has already been noted in *SCIENCE* for April 3. Dr. Caldwell also spoke on "The Junior Academy Movement" at the Saturday morning symposium on stimulation of scientific interest at the high-school level. Six local speakers, three of them sponsors of science clubs in New Orleans high schools, also contributed to this symposium.

In connection with the junior academy movement, the department of physics at Tulane University provided a demonstration lecture by Dr. Walter C. Bosch, especially for science students from the public, parochial and private secondary schools. His subject was "The Magic of Modern Science," and the chief features of the demonstration were the astonishing effects, such as visible sounds and audible light, obtainable by appropriate manipulation of the phenomena of ionization. This is the second year such a demonstration

has been given for a junior audience, and this feature of the annual meeting has proved so popular that admission has had to be by cards distributed through the science departments of the schools, to keep the audience within the limits of size made necessary by the nature of the display itself.

An innovation this year in connection with the Junior Academy movement was an exhibit of models, demonstrations, collections and dissertations by members of the high-school science clubs. This was kept open throughout the two days of the annual meeting.

High in importance among the items of business transacted at the annual meeting was the election of Dr. Robert Glenk, formerly curator of the Louisiana State Museum, and Dr. Isaac Monroe Cline, formerly in charge of the New Orleans office of the Weather Bureau, to the grade of honorary member. Honorary membership in the New Orleans Academy is not an honor conferred upon persons residing at a distance, but a special form of life membership bestowed upon active members by vote of the entire academy, in recognition of their services to science and to the academy itself. Both Dr. Glenk and Dr. Cline are

past presidents of the academy and have for many years been outstanding members of the group of scientists residing in New Orleans. Honorary members previously elected are Dr. Rudolph Matas and Dr. Brandt Van Blarcom Dixon.

Fifty-six active members and twenty-two associates were elected in connection with the annual meeting, bringing the total membership of the academy to 221, as follows: Honorary, 4; life, 1; active, 185; associate, 31.

The officers elected for 1936-1937 are: *President*, Dr. Ernest Carroll Faust, Tulane University; *Vice-President*, K. A. Maring, S.J., Loyola University; *Secretary*, Philip C. Wakeley, National Forest Service; *Treasurer*, Dr. D. S. Elliott, Tulane University.

Dr. Howard R. Mahorner, recipient of the 1935 grant in aid of research made by the American Association for the Advancement of Science through the New Orleans Academy, reported briefly on his critical checking of hitherto accepted factors resulting in goiter, a study made possible at this time by the grant.

PHILIP C. WAKELEY,
Secretary

REPORTS

REPORT OF THE COMMITTEE ON RESEARCH OF THE AMERICAN PHILOSOPHICAL SOCIETY¹

IN view of the fact that three years have passed since the society authorized the establishment of the committee on research and since previous annual reports have not been published, it seems advisable at this time to review the work of these three years and to summarize the results. The charter under which this committee is acting is contained in the following resolution recommended by the committee on policy and adopted by the society at the general meeting, April 20, 1933: "*Resolved*, that a Standing Committee of at least five members representing the several fields of knowledge be appointed by the Council to make recommendations in regard to appropriations for the advancement of knowledge through investigation." On June 14, 1933, the council appointed the following members of this committee: Roland S. Morris, *president*, Edwin G. Conklin, *vice-president*, John A. Miller, *secretary*, President Karl T. Compton, Professor James T. Young. At the same time the council authorized the finance committee to include in the budget the sum of \$50,000 a year for grants in aid of research.

The committee organized with Dr. Conklin as chairman, and early in 1934 adopted a series of general principles and rules defining its purposes and plan

of operation, a blank form of application for grants, and a form of agreement to be entered into by each recipient of a grant. These were printed and submitted to the society at its general meeting in 1934, and they have been in use ever since.

President Compton and Professor Young found it necessary to retire from the committee after nearly two years of faithful and often laborious service, and their places have been taken by Dr. W. F. G. Swann and Secretary William E. Linglebach. Dr. Hugh S. Taylor and Dr. Isaiah Bowman were added to the committee one year ago.

Since its organization the committee has met every two months from October to June, inclusive. Applications and supporting recommendations are manifolded and sent to each member of the committee several days before the stated meeting at which they are to be considered. The members of the committee have taken their duties seriously and in some cases have interviewed the applicants or some of their sponsors in attempting to assess the merits of the applications. Whenever the committee has been in doubt about the merits of a particular application, it has sought and obtained the advice of scholars expert in that field; the committee is deeply indebted to the many persons who have thus aided it.

The total number of applications received and considered by the committee since its organization is 214, and the total amount requested was nearly \$400,000. Somewhat more than 100 applications were

¹ Presented at the general meeting of the society April 24, 1936.

received during the first two years, and slightly less than 100 during the past year.

Each year since the organization of this committee, the finance committee, on recommendation of the council, has budgeted a specific sum for grants in aid of research. In 1933 this sum was \$20,000, in 1934 \$45,000, in 1935 \$60,000, in 1936 \$50,000. There has thus been placed at the disposal of the committee on research, for the four years named, a total sum of \$175,000.

Altogether 98 grants have been made of an aggregate sum of \$147,670. Of this sum \$125,467.41 has been actually paid out, while \$22,202.59 is still in the hands of the treasurer awaiting distribution to applicants. Miscellaneous expenses have amounted to \$225.96, leaving a balance for distribution during the remainder of 1936 of \$27,104.04.

The distribution of these grants to the various fields of learning is shown in Table I.

TABLE I

Field	Grants	Amount
Mathematics	1	\$ 1,500
Astronomy	10	17,250
Physics	14	21,500
Chemistry	6	8,500
Engineering	2	4,000
Geology, Paleontology, Oceanography	9	11,975
Botany	14	16,150
Zoology	16	13,350
Physiology and medicine	9	11,700
Psychology	2	1,925
Philology	3	6,300
History	1	1,400
Archeology	5	14,850
Ethnology	1	2,000
Political economy	2	6,850
Literature	2	8,000
Biological Abstracts ..	1	3,500
Total	98	\$149,750
Refunded from vari- ous grants		2,080 = \$147,670

The committee has attempted to follow up the work of recipients of grants by requesting a semi-annual report of progress, by publication of some of these reports in the American Philosophical Society's *Miscellanea*, and by presentation of some of the more interesting reports at certain sessions of the general meeting, or at some of the monthly meetings of the society. Owing to the crowded character of the program at the general meeting in April it is not possible to make place for many papers from recipients of grants; consequently the committee on research has proposed and the council has approved the holding of an autumn meeting, probably on the Friday and Saturday following Thanksgiving Day, at which meeting reports on work aided by grants from the Penrose Fund would form a principal though not an exclusive part of the program. Such a general autumn meeting is needed not only to acquaint the society and the public with what is being done by the society in the

promotion of research, but also to afford an additional opportunity for the scattered members of the society to come together. The National Academy of Sciences, the American Association for the Advancement of Science and several other nation-wide societies hold two or more general meetings each year, and this serves to keep up the active cooperation of members and to stimulate the interest of the general public in the promotion of knowledge. It is proposed that the American Philosophical Society make the same generous provision for the free entertainment in Philadelphia of non-resident members and invited speakers at this autumn meeting as is now in force at the spring meeting.

The question will certainly arise in the minds of some members, if it does not come to open expression, as to whether the results of researches supported by the society are worth all that they have cost. The committee has exercised care in the choice of projects to be supported, but undoubtedly some of these have yielded much more valuable results than others. It is in the very nature of research that the results can not be foreseen. In the main the committee has preferred to support projects which are already under way and where the chances of success are great. Many grants have been in the nature of emergency support of work which would have been permanently or temporarily abandoned but for such support. With a single exception grants have not exceeded \$5,000, and the average size has been \$1,500. The committee believes that with the funds at its disposal it can accomplish more good by making relatively small grants to a large number of persons than by the reverse process. It is true that this method may not make so impressive a show as would the support of a few large projects, but by distributing funds widely there is less risk of making great mistakes, and furthermore if we were to concentrate on a few large projects we would necessarily leave out many fields of research which are represented in the membership of the society. In further favor of these grants of moderate size is the fact that they fill a gap between the larger grants of the great foundations and the smaller ones of the National Research Council and some other organizations. It has been suggested that our society should establish research fellowships of a kind similar to those of the National Research Council. Certainly our present plan of making grants for research should not be regarded as permanently fixed. We should continually study to find the best means for promoting knowledge and the committee on research will welcome suggestions as to feasible ways of improving this work of the society.

EDWIN G. CONKLIN,
Chairman

SPECIAL ARTICLES

FERTILITY AND CONTRACEPTION IN URBAN WHITES AND NEGROES¹

IN a series of earlier papers² there has been described in detail the manner in which data have been collected regarding the complete reproductive histories to the date of record of 30,949 women overtly fertile in 1931 or 1932, and resident in or near 26 large cities in 14 states³ and the District of Columbia, east of (or on) the Mississippi River and north of the southernmost tier of states. These details need not be repeated here. It will suffice to say that all the statistical tests that it has so far been possible to apply indicate that the sample is, within the defined limitations, imposed by the plan of collection of data, justly representative of the general population of women from which it was drawn.

After the long and tedious labor necessary to prepare for tabulation and tabulate this mass of material, it is now possible to report upon some of the results. The final definitive report on the whole investigation is now in preparation, and it is hoped may be issued within a year in book form.

The present paper discusses the question of the comparative fertility of whites and Negroes as exhibited in this material. It is plainly impossible to discuss fertility in human groups without taking account of contraception, since this is certainly one of the most important variables influencing individual and group diversities in expressed fertility in man. It can obscure or completely alter the expression of variation in natural, innate fertility. There are two aspects of contraception that must always be separately considered in attempting to appraise quantitatively its effect on group fertility. The first of these is the *extent* to which its practice is attempted in the group; the second is the *degree* to which, as *actually practiced* in the group, it achieves its object of preventing conceptions. No contraceptive technique now in practical use is completely reliable. To be successful, all require a certain minimum of intelligence, self-restraint and knowledge

of at least the basic elements of the physiology of reproduction. Human beings vary widely in respect of each of these three attributes. A consequence is that contraception may be, and often is, practiced in such a manner that it prevents few if any conceptions; while more intelligent women so manage it as never throughout their reproductive lives to experience an unwanted or unplanned pregnancy.

Table 1 shows the proportion of the women in the present sample who attempted to practice contraception.

TABLE 1
CONTRACEPTION

Practice of contraception	Whites		Negroes	
	Number	Per cent.	Number	Per cent.
No contraception	13,682	54.0	4,676	83.0
Contraception attempted in some form	10,806	42.7	925	16.4
No contraception stated, but record doubted	822	3.2	32	.6
No information	6	.02		
Totals	25,316	99.92	5,633	100.0

Considering first the whites it is seen that 42.7 per cent. of the women had practiced contraception before the time of record, regularly or intermittently, intelligently or stupidly, as the case may have been. Fifty-four per cent. of the women stated that, to the time of record, they had never practiced contraception. The medical cooperators who took and recorded their reproductive life histories for this investigation found no reason in their demeanor, behavior or histories to doubt their statements. Nor did the writer, who went carefully and critically over every detail of each of the 30,949 individual histories with this particular point in mind, find any internal evidence in these 13,682 histories themselves to justify doubt as to their truthfulness on this point.

In addition to this 54 per cent. of the white women 822 or 3.2 per cent. also stated that they had never practiced contraception, but either the medical cooperators or the writer, or both, found reason to doubt their statements on the point. If a woman's record showed too long gaps between pregnancies, unexplained in the history by illness or otherwise, and she affirmed that she had not practiced contraception, her record was forthwith thrown into the doubtful category. Doubtless this was unjust to many women—they probably were in fact telling the truth—but the adoption of the procedure followed had the effect of measurably increasing confidence in the residual 54 per cent. accepted as not practicing contraception.

¹ From the Department of Biology of the School of Hygiene and Public Health, Johns Hopkins University. The substance of this paper was presented at the annual meeting of the American Association of Physical Anthropologists in New Haven on May 2, 1936. The writer desires gratefully to acknowledge his indebtedness to the Milbank Memorial Fund for continuing support of the investigation from which the data here presented have been taken.

² R. Pearl, *Human Biology*, Vol. 4, pp. 363-407, 1932; *ibid.*, Vol. 6, pp. 354-401, 1934; *Milbank Mem. Fund Quarterly Bulletin*, Vol. 14, 1936. In press.

³ These 14 states were Massachusetts, New York, New Jersey, Pennsylvania, Maryland, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Missouri, Tennessee and Kentucky.

TABLE 2
MEDIAN PREGNANCY RATES PER 100 COMPUTED OVULATIONS IN WOMEN MARRIED ONCE ONLY,
AND WITHOUT ANY GYNECOLOGICAL DISEASE

Age period at risk	Not practicing con- traception		Attempting contraception in some manner or form		Difference	Diff. P.E. Diff.	Percentage of contraceptive to non-contraceptive preg- nancy rates
	N	Median Rate	N	Median Rate			
Part A. Whites							
10-14	203	0.60 ± .71	101	0.62 ± .96	+ .02 ± 1.21	0.02	103.3
15-19	5080	8.14 ± .26	3884	3.81 ± .17	- 4.33 ± .31	14.0	46.8
20-24	6605	8.34 ± .20	7476	4.56 ± .11	- 3.78 ± .23	16.4	54.7
25-29	4132	7.16 ± .21	5532	4.51 ± .13	- 2.65 ± .25	10.6	63.0
30-34	2092	6.19 ± .25	2577	4.61 ± .21	- 1.58 ± .33	4.8	74.5
35-39	909	6.84 ± .41	904	4.98 ± .38	- 1.86 ± .56	3.3	72.8
40 and over .	226	7.27 ± 1.01	149	7.65 ± 1.23	+ .38 ± 1.24	0.3	105.2
Part B. Negroes							
10-14	147	0.69 ± 1.23	37	0.69 ± 1.42	0 ±	0	100.0
15-19	1688	7.97 ± .45	413	6.52 ± .68	- 1.45 ± .82	1.8	81.8
20-24	1608	8.37 ± .38	483	7.57 ± .57	- .80 ± .69	1.2	90.4
25-29	883	7.25 ± .35	293	6.84 ± .75	- .41 ± .83	0.5	94.3
30-34	378	6.89 ± .55	135	7.21 ± .96	+ .32 ± 1.11	0.3	104.6
35-39	122	8.44 ± .97	48	8.83 ± 1.48	+ .39 ± 1.77	0.2	104.6
40 and over .	27	6.50 ± 2.14	9*

* Too few to give a reliable median.

Among the Negro women only 16.4 per cent. in total had practiced contraception. As for the remainder, 83 per cent. of the total stated that they had never done so, and no reason was found by anybody to doubt their statement. This left 32 women, or 0.6 per cent., whose statements that they had not practiced contraception were doubtful for one reason or another.

It seems probable for reasons discussed in detail elsewhere that the percentage of white women definitely recorded in Table 1 as practicing contraception somewhat underestimates the corresponding percentage for the general population from which the sample was drawn, but not greatly so. Considering the fact that the figures of Table 1 include all ages; all durations of marriage; the whole range of variation in number of pregnancies experienced; and all sorts of social, economic and educational levels, it would seem hazardous to estimate the percentage of white contraceptors among the women in the general population of the 15 states dealt with at more than 55 to 60 per cent. (that is, $42.7 + 3.2 + \text{about } 10 \text{ to } 15$).

Table 2 gives, as an index of fertility, the pregnancy rates,⁴ by five-year age periods of exposure to risk of becoming pregnant, for two relatively homogeneous groups of white and Negro women respectively. These are (a) women who had never made any attempt to practice contraception during any part of their reproductive life to the date of record, and (b) women who had regularly or intermittently, intelligently or stupidly, attempted to prevent or control the incidence of pregnancy by some method, technique or mode of sexual behavior. The logical contrast is then between

⁴ Number of pregnancies per 100 computed ovulations during a defined time period of risk of becoming pregnant. For a discussion of the theoretical basis and mode of computation of these pregnancy rates see R. Pearl, *Lancet*, Vol. II for 1933, pp. 607-611, and *Human Biology*, Vol. 6, pp. 355-401, 1934.

TABLE 2.—(Continued)
PART C. DIFFERENCES BETWEEN WHITE AND NEGRO NON-
CONTRACEPTORS IN MEDIAN PREGNANCY RATES

Age period	Difference	Diff. P.E. Diff.
10-14	+ 0.09 ± 1.42	0.06
15-19	- .17 ± .52	0.33
20-24	+ .03 ± .43	0.07
25-29	+ .09 ± .41	0.22
30-34	+ .70 ± .60	1.17
35-39	+ 1.60 ± 1.05	1.52
40 and over ..	- .77 ± 2.36	0.33

"non-contraceptors" as a class, and "contraceptors" of all sorts and degrees as a class. The "contraceptor" class includes without selection the stupid and careless as well as the intelligent and foresighted, together with all those falling in intermediate categories in these respects. Because of the considerable skewness of the pregnancy rate frequency distributions the median rather than the mean is the centering constant of choice, and is here tabled.

In all four classes, white, Negro, contraceptors and non-contraceptors, the only women included are those who were married, had been married once only, and who were free of any form of gynecological disease. These restrictions are imposed to ensure still further homogeneity.

Students of fertility will note that the form of age fertility curve indicated by the data of Table 2 is not the familiar one typified, for example, by Körösi's results. The reasons for the difference can not be discussed in detail here for lack of space,⁵ but it arises essentially because in the present material (a) the same individual woman's reproductive performance is followed throughout her entire reproductive life, and (b) in the last age period (40 and over) the only

⁵ For a fuller discussion of this point the reader is referred to a forthcoming paper in the *Milbank Mem. Fund Quarterly Bulletin*, Vol. 14, 1936.

women included are those who were pregnant at least once in that period.

The rates upon which Table 2 is based are fundamentally the rates of the type

$$(A) = \frac{\text{Number of pregnancies in an age period}}{\text{Total woman-years exposure to risk of pregnancy in the same age period, of women who actually became pregnant in that or some later period,}}$$

whereas the usual expression of a fertility rate is of the type

$$(B) = \frac{\text{Number of births in an age period}}{\text{Total number of women potentially capable, because married, of becoming mothers in the same period}}$$

Obviously these are different kinds of rates, and will lead to quite different numerical results. But while rates of type (A) can not be directly compared with those of type (B), any two rates of type (A) may as justly be compared with each other as may any two rates of type (B) be compared with each other.

From Table 2 the following points emerge:

1. In the absence of contraceptive efforts the pregnancy rates of white and Negro women in this substantial body of material are identical, well within the errors of sampling, as is shown in Part C of the table. This is true for all age classes. No racial difference in fertility in the table, so far as concerns non-contraceptors, even approaches three or still less four times its probable error.

2. Among the white women in this material contraception, as practiced, is significantly effective in reducing pregnancy rates below those of corresponding classes of non-contraceptors, as is shown in Part A of the table. This is true for all age classes except the extreme ones (10 to 14 and 40 and over). The percentage reduction in pregnancy rates associated with the practice of contraception is substantial, ranging from roughly 25 to over 50 per cent., except for the extreme age classes mentioned. It should be emphasized that these figures represent the results of contraception as actually practiced in a sample of the general population, and include the inefficient techniques and stupid efforts along with the efficient and the shrewd.

3. Among the Negro women in this material contraception, as practiced, is without statistically significant effect in lowering pregnancy rates below those of comparable classes of non-contraceptors. In two age classes (15 to 19 and 20 to 24) there is some lowering of pregnancy rates, but only between about 10 and 18 per cent. The present data confirm and extend the experience of birth control clinics to the effect that

the general run of Negroes do not practice contraception effectively, even after they have been instructed.

There is thus presented an interesting picture of two racial elements in the same population with substantially identical normal, innate fertility. In one of these groups something over a half practice birth control effectively enough to reduce their normal fertility from a quarter to a half; in the other only a little over 15 per cent. attempt birth control at all, and do it so inefficiently as to produce no significant effect statistically upon their normal fertility. Plainly if there were no other variables involved, such as mortality, for example, the effect of such a situation in altering the relative proportions of the two elements in the population would be apparent in a comparatively short time. But in this case there are other, and compensating variables at work. Pregnancy rates furnish an index of maximum realized fertility. Live birth rates for the same groups fall below pregnancy rates because of reproductive wastage (abortions, miscarriages, stillbirths). Table 3 shows, for 20 of the 26 cities for which the present data were collected, the

TABLE 3
LIVE BIRTH RATES PER 1000 POPULATION: 1932

City	White	Colored
Akron	15.0	17.0
Baltimore	16.3	21.7
Boston	22.0	19.8
Buffalo	17.6	22.5
Chicago	13.9	17.7
Cincinnati	16.8	14.6
Cleveland	16.6	16.2
Columbus	15.8	16.9
Detroit	15.8	16.9
Indianapolis	16.0	17.5
Jersey City	20.9	26.5
Louisville	17.0	15.7
Memphis	17.5	18.3
Nashville	22.1	19.7
New York City	15.3	19.4
Philadelphia	15.9	19.5
Pittsburgh	19.3	19.7
St. Louis	15.2	18.0
Toledo	14.9	13.5
Washington, D. C.	19.1	24.6
Unweighted averages ...	17.15	18.79

number of live births recorded by the Bureau of the Census, per 1,000 population, in 1932. The six cities omitted have so small a colored population as not to warrant computation of separate rates for them as a group.

From Table 3 it appears that in 1932, in 14 of the 20 cities listed, the crude live birth rates for the colored (all but an insignificant fraction of whom were Negroes in the sense of this paper) were higher than those for the whites, and on an average for the 20 cities were 1.64 points higher. Naturally in a finer analysis the age specific birth rates should be compared. The relatively much less frequent practice of contraception and its lower efficiency when practiced among the Negroes as compared with the whites, on the one hand, and the much higher reproductive wastage rates in the Negroes

than in the whites, partly consequent upon a greater prevalence of venereal diseases among Negroes, on the other hand, act as compensating factors upon the live birth rate. In any final definitive treatment of the problem every possible effort will have to be made to disentangle the relative quantitative influence of these variables.

The analysis of the data is being continued.

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BIOELECTRICAL POTENTIAL IN HEAVY WATER

IN a recent review¹ of the biological effects of heavy water it was suggested that deuterium may modify physiological processes by altering bioelectrical potentials. This hypothesis is now supported by the following experiments on the potential difference across the skin of the frog.

Belly skin from a male frog was tied over the end of a short tube (internal diameter 1.5 cm) supported in a liter jar immersed in a thermostat at 26.2° C. Air at 26.2° C. was passed continuously through the jar. The electrodes consisted of cotton soaked in Ringer's solution fastened to chlorinated Ag wires leading to the usual potentiometer circuit (all readings were corrected for electrode potentials of a few millivolts). Ringer's solution containing 2 grams of glucose per liter and buffered to pH 8.2 was evaporated on a steam bath and redissolved in equivalent amounts of 96 per cent. heavy water or distilled water (controls). The cotton electrodes absorbed 1 cc of solution and 4 drops were placed on each side of the skin.

After a preliminary run in H₂O Ringer to establish the potential of the preparation the skin was carefully blotted and D₂O Ringer was added, including new cottons soaked in D₂O Ringer. Fig. 1 represents a typical experiment showing the striking fall in potential in heavy water (graph indicated by triangles). Control skins treated in the same way but changed to the fresh H₂O Ringer regained their original potential (graph indicated by circles). The falls in peak potential in four skins transferred to heavy water were: 46.6 to 21.2 mv; 90.2 to 34.4 mv; 83.3 to 25.5 mv; 38.2 to 20.8 mv.

The results indicate that the e.m.f. of the skin is produced by a continuous metabolic process,² for the reduction brought about by heavy water is too great to be explained by modification of a simple physical property such as electrolytic dissociation. It is clear that many of the physiological effects of heavy water

¹ T. C. Barnes and T. L. Jahn, *Quart. Rev. Biol.*, 9: 292, 1934.

² E. J. Lund, *Jour. Exp. Zool.*, 51: 265, 1928. For additional references cf. E. J. Boell and A. B. Taylor, *Jour. Cell. and Comp. Physiol.*, 3: 355, 1933; W. L. Francis, *Jour. Exp. Biol.*, 11: 35, 1934.

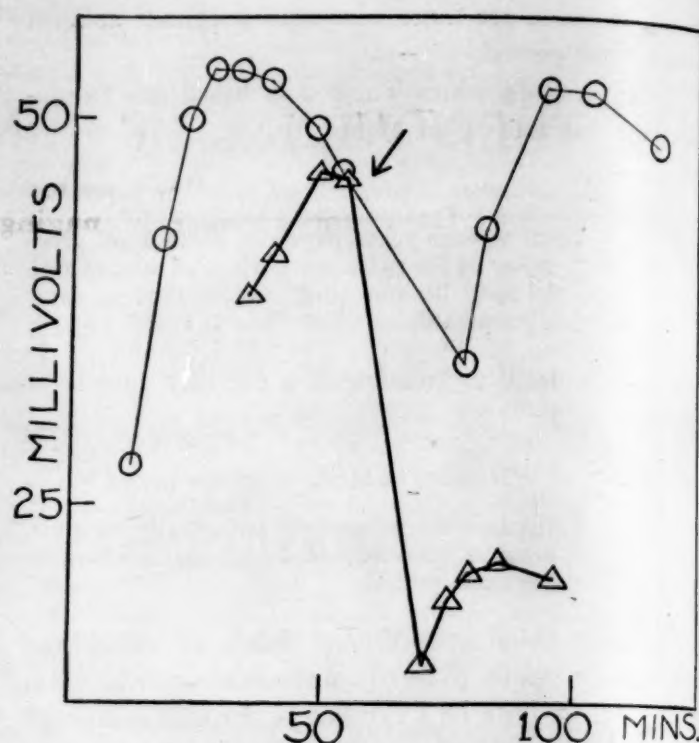


FIG. 1. Reduction of the potential of frog skin in heavy water. Ordinates: e.m.f. in millivolts (outside surface is negative). Abscissae: time in minutes after excision of skin. Circles: Control in H₂O Ringer. Triangles: skin transferred to D₂O Ringer (at arrow).

may be essentially electrical. Similar experiments on the electrocardiogram of the frog are in progress.

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BOOKS RECEIVED

- Archivos do Museu Nacional*. Vol. XXXV, 1933. A Flora do Rio Cumindá. Pp. 206. 12 plates. *Boletim do Museu Nacional*. Vol. X, 1934. Pp. 151. Illustrated. Vol. XI, No. 1, March, 1935. Pp. 126. Vol. XI, No. 2, June, 1935. Pp. 120. Museum Nacional, Rio de Janeiro, Brazil.
- Brooklyn Botanic Garden Record*. Vol. XXV, No. 2, April, 1936. Twenty-fifth Annual Report. Pp. 206. Illustrated. Brooklyn Institute of Arts and Sciences.
- COOK, SHERBURNE F. *Elementary Human Physiology*. Pp. xi + 539. 135 figures. \$3.50. *Laboratory Manual in Elementary Human Physiology*. Pp. 76. Harper. \$0.30.
- CRONEIS, CAREY and WILLIAM C. KRUMBEIN. *Down to Earth: An Introduction to Geology*. Pp. xviii + 501. Illustrated. University of Chicago Press. \$3.75.
- PETERMANN, B. and KARL HAGGE. *Gewachsene Raumlehre*. Pp. viii + 165. 275 figures. Herder, Freiburg, Germany.
- Science Reports of the Tôhoku Imperial University. First Series; (Mathematics, Physics, Chemistry)*. Vol. XXIV, No. 5. February, 1936. Pp. 242 + 8. 28 figures. 2 plates. Maruzen Company, Sendai, Japan.
- SMYTH, NATHAN A. *Through Science to God*. Pp. 213. Macmillan. \$2.50.
- STEVENS, BLAMEY. *The Identity Theory*. Second edition, revised. Pp. xvi + 243. 29 figures. Sherratt and Hughes, Manchester, England. \$2.00.
- Texas Almanac and State Industrial Guide*. 1936 Texas Centennial Edition. Pp. 512. Illustrated. The Dallas News. \$0.65 postpaid.
- Why We See Like Human Beings*. Pp. 128. Illustrated. Better Vision Institute, Rockefeller Plaza, New York.